



CHEETAL

JOURNAL OF

The Wild Life Preservation Society of India

Vol. 20

Dec. 1978/March 1979

Nos. 2 & 3

TIGER IN GRASSLAND.





Wet Evergreen Forests—Bhutan.



Moist Deciduous Forests Corbet Park—Dahikalachor.

(See Article on Page 35)

CONTENTS

1. Speech of the President Col. Pratap Singh Malvendra of Nabha at the 20th Annual General Meeting of the Wildlife Preservation Society of India on 14th January 1979	...	...	i
2. Speech delivered by the Chief Guest Shri B.P. Srivastava, Inspector General of Forests, Government of India at the Twentieth Annual General Meeting of the Society on 14th January, 1979	...	...	ii
3. Notes	...	...	1
4. Ecology of the Sundarbans Tiger with Particular Reference to Range of Habitats and Adaptability to Changes by Kalyan Chakrabarti	...	...	3
5. Fauna of Corbett National Park by B.S. Lamba and R.K. Bhatnagar	...	...	16
6. The Concept of Social Forestry and the Benefits Derived by the People	...	...	18
7. Eucalyptus and Environment by R.D. Gaur	...	...	26
8. Biography of a Tiger by Col. Sherjung	...	...	29
9. Tigers in the Wild—Their Distribution and Habitat Preferences by Kailash Sankhala	...	...	35
10. A Way to Estimate the Number of Tigers by J.P. Sinha	...	...	58
11. A Brief Note on Project Tiger, Bandipur, Karnataka by D. G. Wesley	...	...	61

Photographs by courtesy of Shri Kailash Sankhala.

APPEAL

The Wildlife Preservation Society of India is purchasing the present office premises to have a permanent home.

Patrons, Members and Sympathisers are requested to donate generously to enable the society to complete the purchase.

Donations big and small may please be sent to the Wildlife Preservation Society of India, 7, Astley Hall, Dehra Dun, U.P. (India). All donations will be gratefully acknowledged and the names of donors published in Cheetal.

The Society has secured exemption under section 80 (G) of Income Tax Act and, therefore, donors will get a suitable concession in Income Tax.

Executive Committee

*

*

*

*

Members and Subscribers are requested to note that all yearly subscriptions fall due on 1st of April each year. They are requested to pay in time so that Cheetal may be sent to them regularly.

Change of address should be intimated at the earliest to prevent Cheetal being lost in transit.

Honorary Secretary.

**Speech of the President Col. Partap Singh Malvendra of Nabha at the
20th Annual General Meeting of the Wildlife Preservation Society
of India on 14th January 1979**

Guests, Members and Friends,

I am very happy to welcome you all to this Twentieth Annual General Meeting of the Wildlife Preservation Society of India.

It gives me great pleasure to welcome today Mr. B.P. Srivastava, Inspector General of Forests, Government of India, as our Chief Guest at today's function and for giving us his valuable time from his busy programme to guide us to conserve our flora and fauna which is fast dwindling. This can only be done if you help in saving them from getting completely extinct, for this is a very rich heritage which we inherited and if we do not do something now, it will be too late.

Wildlife preservation is gaining momentum in the country as we often see notes, articles, photographs, constructive ideas and sometime destructive criticism in magazines and newspapers. There is also a mushroom growth of Wildlife and Natural History societies which is a good sign for the future.

Success of Project Tiger is a remarkable achievement of the Government and we now have eleven Tiger reserves. The Society has always supported conservation projects and will continue to do so in future. The more important problem now is the conservation of the habitat and the enforcement of Wildlife laws, rules and regulations and sportsmanship in 'Shikar'.

Wildlife-products have been commercialised and herein lies the danger, because commerce knows no bounds.

To me the most effective way for conserving wildlife could be through more creative interest in conservation among the youth of the country and by bridging the gap between precept and practice. Let the youth be exposed to the forests and wildlife to a greater extent and the future of wildlife will be assured because the youth of today will be the decision-makers of tomorrow.

The Society has been rendering service for the last twenty years to the cause through its journal 'Cheetal' which is the only journal of its kind in Asia.

The report on the working of the Society during the year 1977-78 and the audited accounts have been open to the members for sometime and it will be clear that the Society has been in the red. It needs your and your friends' support to make it self-supporting.

I thank the office bearers and staff of the Society for all they have done to promote the cause of wildlife conservation and to serve the Society without which all that has been achieved could not have been accomplished.

Speech delivered by the Chief Guest Shri B.P. Srivastava, Inspector General of Forests, Government of India at the Twentieth Annual General Meeting of the Society on 14th January 1979

Col. Partap Singh, Dr. Misra, Members of the Wildlife Preservation Society of India, Ladies and Gentlemen.

I consider it an honour to be invited to address this meeting of the Wildlife Preservation Society of India. When Mr. S.K. Roy broached the subject I readily accepted because I have been associated with your Society from its very inception. I was at the Forest Research Institute when the late Mr. P.D. Stracey conceived the idea of starting such a Society and with his characteristic single-mindedness of purpose succeeded in implementing it. It is a pity that he is not with us any more.

I have other reasons too for being with you this afternoon. As the Inspector General of Forests it is my duty to look after wildlife conservation in India but my interest transcends the bounds of duty as I am extremely interested in wildlife conservation. I am happy to note the good work being done by the Wildlife Preservation Society of India in arousing public consciousness towards this important subject and would be very happy to give every possible help and co-operation in furthering the aims of this Society.

There is no doubt that our wildlife has been terribly devastated during the last quarter of a century. I remember the time when the Doon forests were full of game and one could see jungle fowl, deer, pig, panthers and tigers within a few miles of Dehra Dun and that not so very long ago. Today the picture is quite different. We do not see herds of Cheetal and flocks of jungle fowl any more. The forests have become silent—we don't hear the cheetal calling or the tiger roaring. I do not mean that the fauna has disappeared altogether but it has certainly become much less and has receded into such pockets of seclusion as it can find.

Why has this happened? There are several causes which have continued to decimate our beautiful wildlife. The most important cause is the phenomenal increase in the human population which has resulted in an increasing biotic pressure on our forests. Along with the increase in the human population, the population of cattle, goats and sheep has also increased. All this has resulted in the shrinkage of the habitat and an increase in human activities in the forest areas that remain. The proliferation of fire-arms in the rural areas and a general erosion of respect for the law have made matters worse. But in my opinion the worst single cause of decimation of Indian wildlife is the jeep. A jeep can go where even a bullock cart cannot. In the old days poaching was done on foot or by bullock carts which confined the poachers' ambit to within a radius of 8 or 10 km. Poaching by car was confined along the forest roads and since these were well guarded by a rigid system of gates and gatemen it could

not get beyond control. With the coming of the jeep the gates and gatemen became redundant because the jeep could follow any of the numerous cart-tracks going into the forest. The range of activity of the poacher also increased enormously and it became possible for poachers to operate from distances of 100 miles or more and go back to far off towns by next morning making it impossible for the forest staff to catch them.

All these causes combined with a general lack of public consciousness towards the need of conserving this valuable heritage has resulted in a steady decimation of India's wildlife. It is fortunate that it did not take long for Government to realize the situation and start remedial measures. Public opinion, at least among a set of the educated elite has been of great help in strengthening the hands of Government and has resulted in public media taking up the cause. The Wildlife Preservation Society of India has played a significant role in this direction over the last 20 years.

What can we do to preserve for posterity India's rich and varied wild life which inspite of heavy in roads on it has fortunately not totally disappeared, thanks to the efforts of the Forest Departments and their Wildlife Wings. There is a tendency among the protagonists of wild life conservation to demand total protection. This is a measure of their enthusiasm but not, perhaps, of their wisdom. Wildlife is a self regenerating natural resource and should be treated as such. Scientifically planned conservation rather than total preservation is what we need. Total protection is called for archaeological monuments and works of art and not for living beings—particularly of those living beings which exist in a heavily populated and rapidly developing country. A delicate and difficult balance has to be achieved in the competition for land use between man and wildlife. Total protection should be confined to a few selected areas such as National Parks, Sanctuaries and Nature Reserves and to some selected species which are in danger of extinction. Scientific conservation should be practised in the rest of the area and for species which are not in danger and can rapidly breed.

Over reaction to the cause of blind preservation can do more harm than good because it may militate against the interests of the rural population which may become antagonistic to wildlife preservation. It must be realised that the needs of man—particularly the poor man—have to be supervised and any attempts to conserve India's wildlife cannot succeed despite best Government efforts without public co-operation. This requires the necessity of a massive extension programme to educate the masses.

In this field non-official bodies like the Wildlife Preservation Society of India have a very important role to play by educating the youth of the country not only through the medium of a periodical like the "Cheetal" but also arranging lectures, slide shows and film shows in colleges and schools particularly in the rural areas adjoining our forests. Another section of society, perhaps the most important one—the co-operation of which is needed in the conservation of our wildlife—are the women of India. It is through them that the

coming generation can grow up with full realisation of the importance of wildlife conservation. I am glad to note that the Wildlife Preservation Society of India has now many ladies amongst its members.

I would like to touch upon the growing tendency to rely increasingly on foreign experts and foreign expertise in wildlife conservation. While there is no doubt that the West has developed considerable expertise in the conservation of nature and has some of the best run National Parks in the world, it is also true that there is not much knowledge and experience regarding Indian fauna. Whatever knowledge exists is in respect of temperate fauna, of which there is not much variety or of African fauna where experts from Europe and America have had the opportunity to work. At the same time it is even truer that there is a large number of Indians, particularly in the Forest Departments of India who have long and intimate knowledge and experience of our varied fauna. It is they who should be entrusted with the task of providing expert knowledge rather than those who come from abroad, learn about our fauna from us and then submit a project. I am not chauvinistic when I say that Indian fauna can best be looked after by Indians on their own with such help that may be necessary from outside.

I find that there is a growing consciousness on the subject of conservation of wildlife in the magazines, newspapers and journals. This interest is a very good sign. There are a number of societies which are helping us in the preservation of wildlife and your Society is perhaps the senior-most in this laudable cause. I hope the Wildlife Preservation Society of India maintains its leadership role.

The President mentioned in his speech about the Project Tiger. The Project Tiger has done very good work and the tiger population has definitely increased. There is no doubt about it. There has been some controversy in the newspapers, sparked off by a biased article appearing in a foreign newspaper. It is immaterial as to what is the exact number of tigers in India. What is material is that the tiger is increasing and it is safe. I may add that it has never been safer.

I wish the Society every success. I am very proud of being with you today. I am sure your Society will go ahead in the very good cause of preservation of wildlife.

CHEETAL

Journal of the Wildlife Preservation Society of India

Vol. XX

December 1978/ March 1979

Nos. 2 & 3

INTERNATIONAL SYMPOSIUM ON TIGER :

The Wildlife Preservation Society of India is happy that the postponed International Symposium on Tiger is now being held. We welcome the delegates, participants and observers of the Symposium and wish the symposium all success. We also hope that the discussions will lead to a fruitful and practical programme to save the Indian Tiger—not only the tiger but also the associate animals and the habitat.

*

*

*

WILDLIFE EXPERTS:

Shri B.P. Srivastava, Inspector General of Forests, India, addressing the 20th Annual General Meeting of the Society said, "I would like to touch upon the growing tendency to rely increasingly on foreign experts and foreign expertise in wildlife conservation. While there is no doubt that the West has developed considerable expertise in the conservation of nature and has some of the best run National Parks in the world, it is also true that there is not much knowledge and experience regarding Indian fauna. Whatever knowledge exists is in respect of temperate fauna, of which there is not much variety or of African fauna where experts from Europe and America have had the opportunity to work. At the same time it is even truer that there is a large number of Indians, particularly in the Forest Departments of India who have long and intimate knowledge and experience of our varied fauna. It is they who should be entrusted with the task of providing expert knowledge rather than those who come from abroad, learn about our fauna from us and then submit a project. I am not chauvinistic when I say that Indian fauna can best be looked after by Indians on their own with such help that may be necessary from outside." The Society agrees with him.

*

*

*

PROJECT TIGER:

About Simon Winchester's article, 'Shooting Down Paper Tigers' in the Guardian, London, the Inspector General said, "The President mentioned in his speech about the Project

Tiger. The Project Tiger has done very good work and the tiger population has definitely increased. There is no doubt about it. There has been some controversy in the newspapers, sparked off by a biased article appearing in a foreign newspaper. It is immaterial as to what is the exact number of tigers in India. What is material is that the tiger is increasing and it is safe. I may add that it has never been safer."

We agree with Shri B.P. Srivastava, Inspector General of Forests, Government of India that the article was biased and that it was uncalled for, unfair to all and harmed Project Tiger.

*

*

*

FOREST POLICY:

Shri H.M. Patel, Home Minister and Chairman Indian Board for Wildlife is to be congratulated for pinpointing at the Central Board of Forestry meeting the harmful features of India's Forest Policy in theory and more so in practice and the suggestion that the Forest Policy be changed from an exploitation dominated one to one of conservation, particularly in the Himalayan region from Kashmir to Arunachal Pradesh.

The Government of India appears to be keen on saving forests and wildlife and achieving the minimum forest cover of 33% of the land mass but the practice is different in the States. It is important to consider the implications of large scale deforestation by the Forest Corporations and the emphasis on monoculture and industrial forestry.

Let us hope his warning will be heeded and the Forest Policy and practice changed accordingly.

*

*

*

FALCONRY AND THE ARAB PRINCES:

The Arab Princes with a large retinue have been visiting Jaisalmer desert area for nearly a decade during winter for falconry and shooting. Their visit this year sparked a campaign in the press by wildlife conservationists and the visit had to be cut short.

Falconry is a dying sport in India and the Wildlife Protection Act does not provide for falconry licences. The Arab Princes bring trained falcons for the sport. Falcons are a protected species in India but some are exported (smuggled out) on false declarations. Either falconry should be accepted as a sport or completely prohibited.

The agitation and campaign was not against falconry but against the killing of the Great Indian Bustard which is endangered and a fast vanishing bird deserving strict protection—and as such it was essential.

Ecology of the Sundarbans Tiger with Particular Reference to Range of Habitats and Adaptability

BY

KALYAN CHAKRABARTI

Field Director, Sundarbans Tiger Reserve

1. Introduction

Tiger is at the apex of a large and complex biotope in a richly variegated, highly colourful but continually fretful household of Nature. It sounds absurd to consider that India which had been for millennia the most favourite refuge for this magnificent cat now struggles to save it from utter extinction. This possibly is the inscrutable course of natural history that has led the tiger into such a perplexing dilemma.

2. Abstract

The present observations include the habitat zonations of Sundarbans tigers, soil and water salinity ranges of the habitats and the preponderance of the tiger in such zonations. Sundarbans tigers which have inherent tendency of man eating had also been categorized in different types so far as this peculiar behaviour pattern is concerned so that this may facilitate to throw some light into the ecological traits. Statistics on human casualties due to tigers from 1962-63 upto 1978-79 were analysed statistically to form an idea about the unique behavioural trait of this magnificent cat.

3. Unique tiger habitat—Sundarbans

The Sundarbans is a swampy land of diverse eco-system, wherein tidal action promotes a rapid circulation of nutrients, waste products of metabolism, and benthic microflora. The salinity varies considerably both in vertical and horizontal planes. The estuarine organisms exhibit incredible array of adaptations.

The following table shows the different values of desiderata like Mhos/centimetre, pH, total soluble salts, salt percentage at three different soil depths of 15 centimetre, 30 centimetre and 60 centimetre for twelve different habitat formations identified for Sundarbans tiger reserve area:

Habitat formation types	Depth in cm.	Mhos/cm.	pH	TSS	Salt%
(a) Heritiera-Phoenix	15	10.01	7.90	100.0	0.54
	30	11.19	7.95	111.9	0.60
	60	10.01	7.70	101.1	0.54
(b) Heritiera-Excaecaria	15	10.01	8.1	100.1	0.54
	30	9.43	8.05	94.3	0.49
	60	8.78	7.95	87.8	0.48
(c) Heritiera-Excaecaria-Coreops	15	15.32	7.85	153.2	0.84
	30	14.73	7.8	147.3	0.84
	60	18.27	7.8	182.7	1.05
(d) Excaecaria-Phoenix	15	9.05	8.5	90.5	0.49
	30	9.05	8.2	90.5	0.49
	60	9.05	8.0	90.5	0.49
(e) Pure Phoenix	15	12.70	8.1	127.0	0.72
	30	13.25	8.05	132.5	0.72
	60	14.35	8.05	143.5	0.78
(f) Pure Excaecaria	15	11.05	8.20	110.5	0.60
	30	12.15	8.15	121.5	0.66
	60	13.25	8.10	132.5	0.72
(g) Pure Cereops	15	17.32	8.00	173.2	0.96
	30	20.22	7.95	202.2	1.2
	60	28.32	7.70	283.2	1.7
(h) Excaecaria Cereops	15	13.27	7.25	130.7	0.72
	30	15.60	6.25	156.0	0.90
	60	15.02	7.30	150.2	0.84
(i) Rhizophora-Brugiera	15	10.02	6.0	100.2	0.54
	30	9.17	6.2	91.7	0.49
	60	13.45	5.0	134.5	0.72
(j) Pure Oryza	15	6.70	8.10	67.0	0.38
	30	8.27	8.20	82.7	0.44
	60	10.80	8.25	180.0	0.60
(k) Avicennia-Oryza	15	10.97	8.35	109.7	0.60
	30	11.55	8.45	115.5	0.60
	60	15.02	8.35	150.2	0.84
(l) Avicennia-Sonneratia	15	10.02	8.0	100.2	0.54
	30	11.37	8.0	113.7	0.60
	60	19.57	8.0	195.7	1.10

The Javan Rhinoceros (*Rhinoceros sondaicus desmaresti*), Swamp deer (*Cervus dauvacei dauvacei*), wild buffaloes (*Bubalus bubalis*) which were once the pride of Sundarbans no longer exist in the area now. Sundarbans is a curiously anomalous tract where fish (*Periophthalmus* and *Boleophthalmus*) creep up the tree, tides in the same creek sometimes run in opposite directions, molluscs and crustacea are in abundance. The tigers operate in such a peculiar saline terrain and their behavioural pattern and adaptations are simply bewitching.

4. Habitat formation, salinity index and human casualties due to tiger

It is a point of controversy if the habitat formations and salinity indexes both for soil and water maintain any correlation to the man-eating propensity of Sundarbans tigers. A statistical analysis of the data collected from topical habitat formations, salinity indices and man-eating tends to throw some light into this age-old controversy. Table Nos. 1 & 2 exhibit the data and analysis.

A close look to the table gives an indication that the 'habitat formation' 'Pure Cereops' which records the highest salinity percentage also records the highest incidence of human casualties. The second highest in order in 'habitat formation' is Excaecaria-cereops so far as a salinity percentage is concerned. The third, in order is from the 'habitat formation' 'Heritiera-Excaecaria-Cereops'. A further scrutiny to the order of ranks of difference habitat formations made according to salinity percentage and percentage human casualties also tends to indicate a positive correlation (Spearman's rank correlation was computed as 0.83 as shown above). But the data on percentage frequency of tiger pugmarks records do not exhibit any apparent correlation with that of percentage human casualties and which tends to indicate that man-eating is *not* significantly common in all habitat formations but seems to be concentrated in some particular habitat formations only. For example, habitat formations like Pure Cereops, Excaecaria-Cereops and Heritiera-Excaecaria-Cereops and Heritiera-Phoenix contribute in total about 60% of total human casualties.

5. Man-eating behaviour of Sundarbans Tiger

It had been observed that blocks Chamta, Goashaba, Malta and Gona continued to be the most vulnerable blocks so far as the human casualty due to tiger is concerned. This is the picture till Project Tiger started functioning over 2585 square kilometre in the Project Tiger area in Sundarbans. An analysis of statistics on human casualties starting from 1962-63 to 1978-79 (upto September, 1978) had very clearly indicated about the trend of human casualties in different blocks of the region (Page 8).

Table 1

Habitat formation type	Heriteira-Phoenix	Heriteira-Excaecaria	Heriteira-Excaecaria Cereops.	Excaecaria-Phoenix	Pure Phoenix	Pure Excaecaria	Pure Cereops	Excaecaria Cereops	Rhizophora-Brugiera	Pure Oryza	Avicennia-Oryza	Avicennia-Sonneratia
Average value of Desiderata	Heriteira-Phoenix	Heriteira-Excaecaria	Heriteira-Excaecaria Cereops.	Excaecaria-Phoenix	Pure Phoenix	Pure Excaecaria	Pure Cereops	Excaecaria Cereops	Rhizophora-Brugiera	Pure Oryza	Avicennia-Oryza	Avicennia-Sonneratia
Mhos/cm	10.4	9.4	16.1	9.0	13.4	12.1	22.0	14.6	10.9	8.6	12.5	13.7
pH	7.8	8.0	7.8	8.2	8.0	8.1	7.9	6.9	9.7	8.2	8.4	8.0
TSS	104.3	94.0	161.1	90.5	134.5	121.5	219.5	145.6	108.8	85.9	125.1	136.5
Salt %	0.69	0.49	0.84	0.49	0.72	0.66	1.2	0.96	0.49	0.46	0.60	0.60
Ranking	6	7	3	7	4	5	1	2	7	7	6	6
Percentage frequency of pugmarks recorded	12	2	3	18	20	3	5	15	2.5	1.5	20	2
Percentage human casualties	10	8	10	3	8	8	20	18	0.5	0.5	2	5
Ranking	3	4	3	4	4	4	1	2	7	7	6	5

Table 2

Table showing the calculation of rank correlation co-efficient between salt percentage and percentage human casualties.

Rank of salt % = U_1	Corrected U_1	Rank of human casualties = (V_1) per- centage	Corrected V_1	$D_1 : (U_1 - V_1)$	d_1^2
1	2	3	4	5	6
6	6	3	$3\frac{1}{2}$	$2\frac{1}{2}$	25/4
7	9	4	5	4	16
3	3	3	$3\frac{1}{2}$	$-\frac{1}{2}$	$-\frac{1}{4}$
7	9	4	5	4	16
4	4	4	5	-1	1
5	5	4	5	0	0
1	1	1	1	0	0
2	2	2	2	0	0
7	9	7	$11\frac{1}{2}$	$-2\frac{1}{2}$	25/4
7	9	7	$11\frac{1}{2}$	$-2\frac{1}{2}$	25/4
6	6	6	10	-4	16
6	6	5	9	-3	9

Spearman's rank correlation $\sum d_1^2 = 19 + 58 = 77$

$$\text{is given by : } r = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

In the case of ties the Spearman's rank correlation co-efficient formula is given by:

$$r = 1 - \frac{6 \left[\sum d^2 + \frac{t^3 - t}{n(n^2 - 1)^2} \right]}{n(n^2 - 1)^2}$$

Where d = difference in two ranking

t = number of items involved in tie.

n = total number of items on which this ranking is made.

$$r = 1 - .17 = .83 > .5$$

This indicates that there is a remarkable closeness between the two sets of ranks.

Blocks	Year																
	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79 (upto Sept. 1978)
Chamta	9	13	7	15	5	10	17	2	4	3	1	5	9	8	1	4	3
Goashaba	5	5	4	7	1	3	4	5	4	nil	nil	3	nil	nil	nil	nil	nil
Matla	4	3	2	nil	3	5	2	5	14	10	2	2	1	1	nil	nil	nil
Gona	2	2	3	4	3	nil	3	3	nil	nil	2	nil	nil	1	nil	nil	nil

Project Tiger has started functioning from 1974-75 for all practical purposes and obviously the core area was kept under strict vigilance so that no biotic interference can upset the ecological balance in the area. But this restrictive operation has largely influenced the behaviour pattern and ecology of wildlife particularly the tiger.

1. After Project has started functioning the pattern of human casualty is as follows:—

Blocks	Year					Total	Total human casualties during the past 10 years prior to formation of Tiger Project i.e. from (1964-65 to 1973-74)
	1974-75	1975-76	1976-77	1977-78	1978-79 (upto September 1978)		
Chandkhali	8	10	14	14	6	52	16
Pirkhali	2	14	7	6	8	37	22
Panchamukhani	7	10	6	3	6	32	14
Netidhopani	4	8	3	4	8	27	17
Chamta (1, 2, & 3)	9	8	1	4	3	25	80
Khatuajhuri	2	2	4	2	7	17	17
Arbesi	2	6	2	4	2	16	8

It will appear that the most vulnerable blocks so far as human casualty is concerned during the last 10 years before Tiger Project had started functioning i.e., Chamta, Goashaba, Matla and Gona pale into insignificance and are replaced by Chandkhali, Pirkhali, Panchamukhani, Netidhopani, Khatuajhuri etc. after Project Tiger started operation. This is only possible if the man-eater operating at the vulnerable blocks like Chamta, Matla, Goashaba did migrate to the neighbouring zones and have made those blocks as the most vulnerable now. It is also of interest that the human casualties of Chamta block which record 25 during 1974-75 to 1978-79 (upto September, 1978) have occurred only at compartment 1, 2 & 3 as this falls in the buffer zone as the compartments 4 to 8 of Chamta block are in core area. Chandkhali being the adjacent block of Chamta it is quite natural that the adventurous man-eaters of Chamta have migrated to its adjoining block Chandkhali in search of human prey as Chamta 4 to 8 are in the core area and as human beings are not allowed either to enter or for any other purpose in this particular area.

2. The figures for human casualties for blocks Chamta, Matla and Goashaba were significantly reduced after Project Tiger started functioning as Chamta (4 to 8 compartments), Matla and Goashaba were included in the core area and human preys were not available to the man-eaters in these blocks.

3. Some inherent and designed man-eaters were operative at Chamta, Matla and Goashaba had now migrated to adjoining blocks of buffer zone resulting in greater human casualties in buffer zone bordering core area.

4. Human casualty amongst fisherman is significantly more in buffer zone during Project Period than during the pre-project tiger period as will be evident from figures in Table 3, Page 10.

5. Both official and unofficial sources were tapped to ascertain the reliable figures of human casualties after Project Tiger started operating.

6. The urge for human flesh changes from year to year indicating some rhythmic pattern in the behavioural characteristics of the tiger.

Table 3

Casualty among professional men due to tigers

Year	Honey	Fishing	Timber-trader	Others	Total
1963-64	10	15	3	13	41
1964-65	7	9	3	5	24
1965-66	9	20	2	15	46
1966-67	9	18	4	4	36
1967-68	13	13	2	13	41
1968-69	19	11	13	8	51
1969-70	11	12	6	3	32
1970-71	7	16	1	4	28
1971-72	13	9	—	—	22
1972-73	2	9	1	4	16
1973-74	7	8	—	—	17
1974-75	7	16	10	3	36
1975-76	13	38	3	10	64
1976-77	5	18	4	14	41
1977-78	10	28	—	1	39
1978-79 (upto Sept.					
1978)	6	30	—	2	38

Behaviour pattern of the Sundarbans Tiger

(All have an inherent tendency and potentiality of man-eaters)

Inherent and designed man-eater
(Kills man at sight or hunts men)

25% of tiger population.

Aggressive man-eater
(80%)

Most daring
and cunning
(10%)
(Nocturnal &
swimmer to
boat.
Casualty a
certainty)

Dead body
not re-
coverable.

All cate-
gories of per-
mit holders
are the vic-
tims.

Ferocious (90%)
(Charges at sight)
Casualty a
certainty.

Hental and honey
collectors are
victims mainly.

Dead body
partially
recoverable.

Lusty and
adventurous man-
eater (20%)

(Stalks men,
follows them
along creek and
rivers)

Fishermen are
mostly victims.

Dead body rarely
recovered.

Undesigned man-eater
(Kills men when they encroach
upon their den)
15% of tiger population

Mostly the honey collectors or dry
firewood collectors are victims.
Dead body rarely recoverable.

Encroaches on habitation for
cattle, does not kill men usually
(10%)

Circumstantial man-eater (given a
change it avoids men unless hunger-
injury or old age prompts other-
wise)
60% of tiger population.

In forest habitat; not aggressive.
(Generally kills men when extre-
mely hungry and other natural
animal food is not readily at hand)
(90%)

Timber Coupe workers, honey
collectors etc. are victims. Dead
body partially recoverable.

Responsible for 70% of human
casualties.

Responsible for 20% of human
casualties.

Responsible for 10% of human
casualties.

N.B.—Only 28.5% of the total dead victims are recoverable on an average.

6. Salinity and behaviour pattern of tiger:

Salinity can never be an isolated factor responsible for the man-eating tendency of Sundarbans tigers. The following table shows the average water indices for different blocks in Sundarbans Tiger Reserve areas:

	Name of block	Average water salinity % for twelve months
Northern zone	Pirkhali	1.44
	Panchamukhani	1.24
	Jhillia	1.11
	Arbesi	1.29
	Netidhopani	1.79
	Chamta	1.78
	Khatuajhuri	1.41
Central zone	Harinbhanga	1.34
	Chandkhali	1.81
	Goashaba	1.82
	Matla	1.69
Southern zone	Chhotahardi	1.46
	Mayadwip	2.37
	Gona	2.31
	Bagmara	2.34

Total average

1.45%

Average salinity of different zone

	15 cm.	30 cm.	60 cm.
a) Northern zone (Pirkhali, Panchamukhani, Jhillia, Arbesi, Netidhopani, Khatuajhuri, Harinbhanga)	0.80	0.96	1.04
b) Central zone (Chamta, Chandkhali, Goashaba and Matla)	0.97	0.97	1.03
c) Southern zone (Chhotahardi, Mayadwip, Gona and Bagmara)	1.29	1.33	1.37

Average salinity index of Sundarbans Tiger Reserve (soil salinity) soil depthwise

15 cm. — 1.04
30 cm. — 1.06
60 cm. — 1.12

Soil Salinity % at different depths

Name of the Block	Soil depth	Average salt percentage
Pirkhali	15 cm.	0.63
	30 cm.	0.64
	60 cm.	0.58
Panchamukhani	15 cm.	0.79
	30 cm.	1.04
	60 cm.	1.18
Jhillia	15 cm.	0.75
	30 cm.	0.82
	60 cm.	0.96
Arbesi	15 cm.	0.95
	30 cm.	0.94
	60 cm.	1.03
Netidhopani	15 cm.	1.02
	30 cm.	1.02
	60 cm.	0.99
Chamta	15 cm.	0.96
	30 cm.	0.93
	60 cm.	1.11
Khatuajhuri	15 cm.	1.08
	30 cm.	1.03
	60 cm.	1.12
Harinbhanga	15 cm.	1.35
	30 cm.	1.20
	60 cm.	1.39
Chandkhali	15 cm.	1.10
	30 cm.	1.25
	60 cm.	1.12
Goashaba	15 cm.	1.30
	30 cm.	1.07
	60 cm.	1.14
Matla	15 cm.	0.52
	30 cm.	0.64
	60 cm.	0.74
Chhotohardi	15 cm.	1.02
	30 cm.	1.10
	60 cm.	1.23

Name of the Block

Soil depth

Average salt percentage

Mayadwip

15 cm.

1.40

30 cm.

1.43

60 cm.

1.43

Gona

15 cm.

1.40

30 cm.

1.33

60 cm.

1.30

Bagmara

15 cm.

1.35

30 cm.

1.46

60 cm.

1.51

Table 4

Human casualty due to tiger from different blocks

Block	Year					Total
	1974-75	1975-76	1976-77	1977-78	1978-79	
Chamta	9	8	1	4	3	25
Goashaba	—	—	—	—	—	—
Matla	1	—	—	—	—	2
Arbesi	2	6	—	4	2	16
Jhilla	—	1	2	4	2	9
Khatuajhuri	2	2	1	2	7	17
Harinbhanga	1	3	6	1	4	11
Pirkhali	2	14	7	6	8	37
Netidhopani	4	8	3	4	8	27
Panchamukhani	7	10	6	3	6	32
Chandkhali	8	10	14	14	6	52
Gona	—	1	—	—	—	1
	36	64	41	42	46	229

Analysis of the data above exhibits that although water salinity tends to increase as one proceeds from Northern zone to Central zone and then to Southern zone of the Reserve and the similar pattern was also noticed so far as soil salinity index is concerned but the frequency of human casualties does not vary according to such zonations. This indicates that the man-eaters of Sundarbans are concentrated to some habitat formations only which also incidentally record significantly more salinity. It requires further detailed probe to come to any definite conclusion to ascribe reasons for the man-eating urge of Sundarbans tigers. It may be concluded that the man-eating urge, a peculiar trait marked in a percentage of Sundarbans tiger is governed by cumulative action of physical and chemical environment of Sundarbans. It had been further noted that the abundance or scarcity of prey animals are not directly related to the human casualty figures to tiger.

Conclusion:

Sundarbans is a natural laboratory. It provides astonishing examples as to how a physical and chemical environment can exert influence to the different forms of life. The extent of endogenous and exogenous periodism, osmo-regulatory adaptations amongst different organisms were perhaps nowhere so much pronounced and diversified as they are in Sundarbans. Man-eating tigers — astonishingly cunning and ferocious, world's largest and most ferocious crocodiles, water and land lizards, crab eating spotted deer, monkeys and wild pigs, innumerable varieties of crabs, other wildlife, and more than two hundred species of fish etc. make the area unparalleled.

Further detailed scientific study is likely to throw light into hitherto unknown biological properties of Sundarbans.

Fauna of Corbett National Park

(Continued from Cheetal, Vol. XX, No. 1, September, 1978)

By B.S. LAMBA AND R.K. BHATNAGAR

Family : Irenididae

337. *Aegithina tiphia tiphia* (Linnaeus) : Common Iora.
338. *Aegithina tiphia humei* Baker : Central Indian Iroria.
339. *Chloropsis aurifrons aurifrons* (Temminck) : Northern Goldfronted Chloropsis.
340. *Chloropsis hardwickii hardwickii* Jardine and Selby : Orange bellied Chloropsis.

Family : Pycnonitidae

341. *Pychonotus melanicterus flaviventris* (Tickell) : Blackcrested Yellow Bulbul.
342. *Pycnonotus jocosus pyrrhotis* (Bonaparte) : Kumaon Redwhiskered Bulbul.
343. *Pycnonotus leucogenys leucotis* (Gould) : White-eared Bulbul.
344. *Pycnonotus cafer intermedius* Blyth : Punjab Redvented Bulbul.
345. *Pycnonotus cafer bengalensis* Blyth : Bengal Redvented Bulbul.
346. *Hypsipetes maclellandi maclellandi* Honsfield : Rufousbellied Bulbul.
347. *Hypsipetes flavalis flavalis* (Blyth) : Browneared Bulbul.
348. *Hypsipetes madagascariensis psaroides* Vigors : Himalayan Black Bulbul.

Family : Muscipidae : Babblers.

349. *Pellorneum ruficeps punctatum* (Gould) : Western Spotted Babbler.
350. *Pomatorhinus schisticeps leucogaster* Gould : West Himalayan Slatyheaded Scimitar Babbler.
351. *Pomatorhinus ruficollis ruficollis* Hodgson : Nepal Rufousnecked Scimitar Babbler.
352. *Pomatorhinus erythrogeus erythrogeus* Vigors : West Himalayan Rustycheeked Scimitar Babbler.
353. *Dumetia hyperythra hyperythra* (Franklin) : Rufousbellied Babbler.
354. *Chrysomma sinense hypoleucum* (Franklin) : Western Yelloweyed Babbler.
355. *Turdoides caudatus caudatus* (Dumont) : Common Babbler.
356. *Turdoides earlei earlei* (Blyth) : Striated Babbler.
357. *Turdoides malcolmi* (Sykes) : Large Grey Babbler.
358. *Turdoides striatus striatus* (Dumont) : Bengal Jungle Babbler.
359. *Garrulax leucolophus leucolophus* (Hardwicke) : Himalayan Whitecrested Laughing Thrush.
360. *Garrulax rufogularis occidentalis* (Hartert) : Western Rufouschinned Laughing Thrush.
361. *Garrulax lineatus lineatus* (Vigors) : Simla Streaked Laughing Thrush.
362. *Garrulax lineatus setifer* (Hodgson) : Nepal Streaked Laughing Thrush.
363. *Garrulax erythrocephalus erythrocephalus* (Vigors) : Redheaded Laughing Thrush.
364. *Leiothrix argentauris argentauris* (Hodgson) : Himalayan Silvereared Mesia.

365. *Leiothrix lutea kummaiensis* Whistler : Western Redbilled Leiothorix.
366. *Pteruthius lascapris valdirostris* Koels : Redwinged Shrike-Babbler.
367. *Tuhina nigrimenta nigrimenta* Hodgson : Blackchinned Tuhina.
368. *Heterophasia capistrata capistrata* (Vigors) : Western Blackcapped Sibia.
369. *Muscicapa hyperythra hyperythra* Blyth : Rufous breasted Blue Flycatcher.
370. *Muscicapa leucomelanura leucomelanura* (Hodgson) : Western Slaty Blue Flycatcher.
371. *Muscicapa macgrigoriae macgrigoriae* (Burton) : Western Small Niltava.
372. *Muscicapa sundara whistleri* (Ticehurst) : Western Rufousabellied Niltava.
373. *Muscicapa rubeculoides rubeculoides* (Vigors) : Bluethroated Flycatcher.
374. *Muscicapa tickelliae tickelliae* (Blyth) : Tickells Redbreasted Blue Flycatcher.
375. *Muscicapa sordida* (Walden) : Dusky Blue Flycatcher.
376. *Muscicapa thalassina thalassina* Swainson : Verditer Flycatcher.
377. *Culicicapa ceylonensis calochrysea* Oberholser : Northern Greyheaded Flycatcher.
378. *Rhipidura hypoxantha* Blyth : Yellowbellied Fantail Flycatcher.
379. *Rhipidura aureola aureola* Lesson : Northern Whitebrowed Fantail Flycatcher.
380. *Rhipidura albicollis canescens* (Koelz) : Western Whitethroated Fantail Flycatcher.
381. *Trepsiphon paradisi leucogaster* (Swainson) : West Himalayan Paradise Flycatcher.
382. *Monarcha azurea styani* (Hartlaub) : Indian Blacknapped Monarch Flycatcher.
383. *Tesia castaneocoronata castaneocoronata* (Burton) : Chestnutheaded Groundwarbler.
384. *Cettia pallidipes pallidipes* (Blanford) : Indian Palefooted Bush Warbler.
385. *Cettia flavolivacea flavolivacea* (Hodgson) : Himalayan Aberrant Bush Warbler.
386. *Cettia brunnifrons brunifrons* (Hodgson) : Eastern Rufouscapped Bush Warbler.
387. *Isciniola melanopogon mimica* Madarasz : Moustached Sedge Warbler.
388. *Cisticola exilis tytleri* Jerdon : Yellowheaded Fantail Warbler.
389. *Cisticola juncidis curstans* (Franklin) : Streaked Fantail Warbler.
390. *Prinia hodgsonii rufula* Godwin-Austen : Northern Ashy-Grey Wren Warbler.
391. *Prinia hodgsonii hodgsonii* Blyth : Franklin's Ashy-Gray Wren Warbler.
392. *Prinia buchanani* Blyth : Rufousfronted Wren Warbler.
393. *Prinia cinereocapilla* Hodgson : Hodgson's Wren Warbler.
394. *Prinia gracilis lepida* Blyth : Indian Streaked Wren Warbler.
395. *Prinia subflava terricolor* (Hume) : North Western Plain Wren Warbler.
396. *Prinia socialis stewarti* Blyth : Northern Ashy Wren Warbler.
397. *Prinia sylvatica gangetica* (Blyth) : Gangetic Jungle Wren Warbler.
398. *Prinia criniger criniger* Hodgson : Himalayan Brown Hill Warbler.
399. *Orthotomus sutorius guzratensis* (Latham) : Indian Tailor Bird.
400. *Megalnurus palustris toklao* (Blyth) : Striated Marsh Warbler.
401. *Acrocephalus stentorius brunescens* (Jerdon) : Indian Great Reed Warbler.

(To be continued)

The Concept of Social Forestry and The Benefits Derived By The People

The total geographical area of the hill districts of U.P. is 51,100 sq. km. out of which 21,071 sq. km. is in Kumaon Civil Division and 30,029 sq. km. in Garhwal Civil Division. The total population of these divisions is 18.40 lakhs and 19.69 lakhs respectively which works out to a population density of 87 per sq. km. and 66 per sq. km. Out of this total area of over 51,000 sq. km., an area of 32,545 sq. km. is classified as forests. The break-up of this area in sq. km. is as follows:—

	Kumaon Civil Division	Garhwal Civil Division	Total
1. Under the control of Forest Department	6,460	17,529	23,989
2. Civil and Soyam Forests	3,416	2,941	6,357
3. Panchayat Forests	1,354	679	2,033
4. Private Forests	—	166	166
Total:—	11,230	21,315	32,545

This gives an average of 64% of the total area being covered by forests. In fact quite a large proportion of the forests outside the reserved forests under the control of the Forest Department is sparsely stocked and some of the area classified as reserved forests is also treeless as it remains covered with snow or carries Alpine pasture lands. If the reduced density of the forests is taken into consideration the actual coverage is only 41% which is far below the required minimum of 60% as laid down in our National Forest Policy of 1952. The break-up of the reduced area is as follows:—

(P.C. Chatterji, I.F.S., Additional Chief Conservator of Forests (Garhwal Mandal) U.P. Dehra Dun.)

(To be continued)

Area (in sq. km.)	Remarks
1. Under the control of Forest Department	18,922 Rest of the forests are, treeless as it remains covered with snow or carries Alpine pasture lands.
2. Civil Soyam and Private Forests	1,305 Only about 20% of the total land is dense forest.
3. Panchayat Forests	813 do
Total: 21,040	

The role of the forests is very important in the social life of the hills. The forest lore is so intimately woven in the social fabric that the existence of a hill society without forests cannot be imagined. For all their basic needs, viz.; timber for their houses and fuel for their hearths, fodder for their cattle and fibre for their domestic use, pasturage for their herds and wood for their agricultural implements, and medicines etc. to enumerate some of them, the hill people are so vitally dependent upon the forest that they would be like fish out of water without the forests. It was on account of this vital role which the forests play in the economy and social life of the hills, far important than the role of forests in the plains, that special and exclusive laws had to be enacted from time to time, to determine the rights to be exercised by the hill people in the forests. It was, on this account again that, whereas as much forest as possible was taken into the folds of Government Reserved Forests in the plains, sufficient forests were excluded from the control of Forest Department in the hills to meet the requirement of the local people. Numerous categories of forests, class I and II, Civil and Soyam, Benap and Panchayati etc. were created from time to time in Tehri and Garhwal districts, and Chakrata Tehsil of Dehra Dun district, to meet the same end.

The contribution of the hill forests is, as a matter of fact, none the less important for the welfare of the people of the plains, below. Their role in regulating the rainfall, checking run-off and erosion, increasing the life of Hydel Generation projects by reducing the silt-load, prevention of floods, prevention of damage to agricultural land and irrigation schemes is too well-known.

Prior to 1886, proper attention was not paid by the British to the protection and management of forests. The forests of erstwhile Tehri State also were not very properly looked after. As a result extensive areas were cleared of forests, with the increase in population, for the purpose of cultivation. Trees were recklessly felled also for timber, fuel and fodder. But steps to curb these wanton activities in Kumaon and Garhwal caused much resentment in the local public and in 1921, Kumaon Forest Grievances Committee was appointed to look into the matter. On the recommendations of this Committee, the commercially important forests, which were situated in the catchment areas of the important rivers, were constituted into Reserved Forests and the scattered, small, patches of forest were excluded. These Reserved Forests were further categorised into Class I and Class II. Forests less important from commercial point of view, but more important from soil and water conservation point of view, were kept in Class I and put under the control of the Commissioner. The commercially important forests were categorised as Class II and their management was entrusted to Forest Department. The areas outside Reserved Forests were classified as civil forests and were declared as Protected Forests, under the I.F.A. After this classification, reckless felling of trees started in Class I and the Protected Forests. To counter this, some of the Class I forests were transferred to Class II in 1956 and they came under the management of the Forest Department as a consequence. Balance Class I forests were transferred to Forest Department in 1964.

Similarly, in erstwhile Tehri State 'Awwal' and 'Doyam' forests were constituted into Reserved Forests which were passed on to the management of Forest Department with the merger of the State. The "Soyam" forests, which means IIIrd class forests, were left out to cater for the needs of the local villagers. These were handed over to Revenue Department for control and management, after the merger of the State. Civil Benap forests of Chakrata Tehsil have the same status as the 'Civil' forests of Garhwal and 'Soyam' forests of Tehri.

Panchayat Forests were constituted out of Class I, Class II and Civil forests in Garhwal to meet the demand of local people and to identify and associate them with forests and their management. There are some Panchayat Forests in Chakrata Tehsil of Dehra Dun district also but none exist in Uttarkashi and Tehri districts so far. New Forest Panchayat Act has been enforced since July 1976, superceding all the rules issued on this subject in the past. According to this Act, Revenue Department will have the administrative control and Forest Department will have the technical control over the Panchayati Forests which can be constituted out of Reserved, or other, forests if atleast one-third of the adult bonafide residents of the locality so desire. Constitution of the Forest Panchayat will be the responsibility of the Revenue Department and, after their constitution, Forest Department will step in as technical advisers. Forest Department will claim a share, for the services rendered, out of the net revenue of the Forest Panchayat, the major portion of which will

be spent on the welfare of the community. Creation of Forest Panchayats will go a long way towards the goal of socialising the forests.

All reserved forests under the control of the Forest Department are being managed according to scientific silvicultural principles. The basic principle of scientific forest management is that the total annual removal of trees from any particular area should in no case exceed the total annual increment put on by the trees. The second important principle is that harvesting is to be fully balanced by regeneration through artificial or natural means. The third principal is that the standing forest must be managed in a hygienic manner so as to allow the trees to put on maximum increment. As far as the forests in the hills are concerned their importance in controlling water run-off, moisture conservation and prevention of floods and erosion have always been given paramount consideration and there are many areas in our reserved forests which are being maintained only for protection purposes, where fellings are restricted to the removal of dead, dying and deteriorating trees only.

In contrast to the above, the civil and soyam forests, which are outside the managerial control of Forest Department, are not being managed under any scientific system with the result that though they have the same productive potential, slowly they are being depleted and in some cases have been completely annihilated. The condition of these forests is very delicate, at present. Most of the area is devoid of vegetation, the soil mantle has been washed away and the processes of soil formation have come to a standstill. Due to indiscriminate felling of trees and intensive grazing by the local cattle, the upper layer of soil has disappeared and severe soil-erosion is threatening agricultural land, habitations, roads and irrigation channels. With the disappearance of vegetation from the ridges, the streams of water have also disappeared. Whatever few trees are left there, in the Civil and Soyam forests, they are scattered and the density is very thin. Most of the civil and soyam forests are treeless, they support only thorny bushes, shrubs and grasses. Large scale and continuous lopping of oak and other broad-leaved species is done by village women for cattle fodder. The domestic requirement of the local people is met from these forests without having any regard for silviculture. Boundary of the civil forests is not demarcated on the ground, neither there is any recorded boundary description. Boundaries have been further confused at places due to encroachments. At some places even Reserved Forest has been shown as Soyam forests in the Revenue maps, in Tehri and Uttarkashi districts. The matter has been further complicated by Nayabad grants and distribution of land among landless people out of civil and soyam forests. The main agencies for destroying these forests are the man and his cattle. Reckless felling goes on for timber for houses and animal sheds, agricultural implements and fodder. Bushes, branches etc. are badly lopped by the graziers, the goats kill all the plants by browsing

away their tops, cattle trample the earth and make it impervious to water. Local people set fire to forests, year after year, to get new grasses and some people burn the trees adjoining their fields to facilitate encroachment. Some fires are caused by negligence also. A situation has arrived when, what to talk of forests, not a single tree is to be seen in the vicinity of the villages. It is in the interest of the villagers that these forests are saved from destruction so that their requirement of timber, smallwood, fuel and fodder etc. can be met from them perpetually.

The condition of the Panchayati Forests is somewhat better, though the Panchayati Forests made out of Civil Forests are in no better shape. Panchayat Forest constituted out of Reserved Forests have good and dense forests. Part of these areas still support dense forests of *Banj* oak and other broad-leaved species. It is absolutely essential, in order to save the receding water-streams, that these forests are conserved and carefully nursed. These are sources of water-supply for these important hill rivers which are life-streams of Northern India. Everybody is familiar with the magnitude of the devastating floods which recur, year after year, in the plains. Some Forest Panchayats are conscious of protecting their forests and make every effort to do so. But not all are so careful and, consequently, depletion due to improper and unbalanced exploitation is taking place in such forests. Even the better Panchayats have little technical skill for managing the forests properly and, even though they may be protecting their forests, they are not in a position to ensure future regeneration. Development activities are not possible due to shortage of funds. The Panchayats which don't have good forests lack sources of revenue also and funds are not available for development works. 75% area of such Panchayat Forests, constituted out of civil forests, needs afforestation. Some Panchayat Forests, constituted out of Reserved Forests, do not have any working scheme for the forests which are, as a consequence, not being managed scientifically. Some Panchayat Forests have abundance of industrially important species like Chamkharik, Ash, Walnut, Acer, Buxus, Acsenlus etc. but they are not being exploited in the absence of a Working Plan. Some Forest Panchayats having good forest area have sufficient funds, even then they are not able to manage the forests properly. Some Forest Panchayats are so extensive that they have become unmanageable. In such Panchayats the surplus forest area, after leaving sufficient area for the use of local villages on the basis of population, should be reverted back to the Forest Department, so that they can be managed properly.

So it was realised, gradually, that the primary aim of excluding Class I, Civil, Soyam and Benap forests from the control of Forest Department which was to relieve the Government managed Reserved Forests of the huge burden of rights, to protect and improve the Civil and Soyam forests and to convert them, by scientific management, into well-stocked forests, was failing. It was realised that on one hand, the civil and soyam forests, which

were considered to be nobody's property, continued to be depleted and on the other hand, there was no respite to the Government Reserved Forests which continued to be milked heavily, not only by commercial exploitation but for meeting the demand of local people also, a burden which the Civil and Soyam forests, which were free from all commercial exploitation, were supposed to bear.

Due to these reasons some serious thinking was done in the past. Class I forests were already entrusted to the Forest Department. In order to save the Civil and Soyam Forests from depletion, and ultimate destruction, the U.P. Forest Department has introduced a scheme for their management which started from the first year of the Vth Five Year Plan. The total outlay is of Rs. 650 lakhs. Afforestation, fencing and pasture development are the main features of this scheme, the success of which will entirely depend upon the co-operation and goodwill of the village people. It is here mainly that the role of social forestry comes into play. The villagers have to be taught that oak forests, and other broad-leaved forests, are greatly instrumental in conserving moisture and form the source of the perennial springs. They have to be told that the great shortage of drinking water is mainly due to lopping and felling of oak forests for fodder, cultivation and horticulture. They have to be convinced of the futility of maintaining a large number of undersized and unproductive cattle at the expense of valuable forests and even more valuable drinking water, and that too for producing a small quantity of manure only. The benefits of maintaining a better breed of cattle, albeit in small number, and stall-feeding them so that all the dung can be utilised, will have to be explained to them. The damage caused by goat-browsing should be highlighted and controlling the number of goats, by imposing substantial licencing fees and also grazing dues, should be suggested. Schemes of Patsure development and improvement of sheep-breed should also taken-up simultaneously.

Success of these schemes will depend upon the inconvenience the villagers are prepared to put up with, and self-control they are willing to impose upon themselves, in the interest of the long term benefits that will certainly accrue if the bare hillsides get covered with lush grasslands and dense forests. The habit of cutting freely any tree they want, of grazing cattle indiscriminately, of lopping trees to death at will, will have to be curbed. Therefore the task in the implementation of the scheme, is as much of educating the village people and convincing them of the benefits that will flow in future, at the cost of some inconvenience at present, will be greater than the actual work of afforestation and pasture development.

The enactment of Forest Panchayat Act, 1976, implementation of 3-dimensional integrated Forest-farming and Extensive Tree Plantation Drive have all been taken up with the same goal in the mind i.e. the involvement of the people with the forests and their identification with its welfare.

Another scheme for afforestation of denuded hills and vacant lands, Road-side plantation along pilgrimage routes and soil conservation work in those "Gadheras" and "Nalas" where active soil erosion is taking place, in civil and soyam areas of the Garhwal Civil Division has been submitted to the Government for approval. Almost all area of this Mandal forms the catchment of the important—snowfed and perennial rivers of N. India, main among which are Alaknanda, Bhagirathi, Ganga, Yamuna, Tons, Ramganga and their tributaries. So the importance of soil and water conservation work in this area cannot be overemphasized. In most of the area for which this scheme has been drawn up, the upper soil layer has been washed away. It will be essential to give rest to such areas for some years so that soil forming processes, and micro-biological activities, are under way before afforestation of these areas can be taken up. The main aims of this scheme of social forestry will be:—

- (i) To conserve and extend the existing forest wealth by scientific management.
- (ii) To plant up the denuded area, according to its suitability, with species suitable for meeting the demand of timber, small wood, fuel, fodder and grazing, of the local people.
- (iii) To increase the life-span of irrigation schemes and water-storage reservoirs, by reducing the run-off and silt-load, and to protect the agricultural land and habitations from soil erosion by adopting suitable soil and water conservation measures.
- (iv) To introduce local and exotic palatable forage grasses and fodder trees in areas not suited for afforestation and to induce the local people to abandon the wasteful habit of indiscriminate cattle-grazing and to gradually switch over to stall-feeding.
- (v) To raise orchards in areas unfit for cultivation in order to put the land to its optimum use.
- (vi) To produce raw materials for forest-based cottage industries.
- (vii) To eradicate unemployment.
- (viii) To ameliorate the ill-effects of biotic pressure on the existing forests, the soil and water, and to conserve mountain environment.
- (ix) To ensure drinking water supply to local people.
- (x) To encourage tourism by beautifying the pilgrim routes and raising plantations.
- (xi) To improve the breed of milch and draught cattle and the sheep.

The Forest Department has to play a very vital role in the integrated development of, besides the Reserved Forests, Civil-Soyam and Panchayat Forests and in the programme of Social forestry. In conformity with these principles of social forestry, the Forest Department is already providing substantial benefits to the hill people, in the shape of rights and concessions enjoyed by them, as grant of timber for their houses, cowsheds and agricultural implements; fuel for their domestic use; leaf-fodder, grazing ground for their cattle and sheep-goat, thatching material; Bamboos; fencing material; Ringal for basket-making; slates for roofing and medicinal herbs etc. It is note worthy that the hill districts of U.P. enjoy the unique privilege of getting free timber, minor forest produce and grazing to the tune of over rupees one and a half crores annually from the reserved forests in these hills. Rights to such a large extent are not enjoyed by the villagers living in the vicinity of the forest in any other part of the State or of any other State in the country. The approximate quantity and value of the forest produce and grazing, provided free, annually, is given below:—

Type of Produce	Quantity	Value in Rs.
A — Major Produce		
(i) Timber (Sawn)	40,000 cu. M.	60,00,000/-
(ii) Fuel	7,50,000 cu. M.	75,00,000/-
B — Minor Produce		
(i) Bamboo	1,50,000 nos.	30,000/-
(ii) Ringal	80,00,000 "	20,000/-
C — Grazing		
(i) By right-holders under settlement	11,00,000 cattle	16,50,000/-
(ii) Otherwise than under settlement	1,00,000 "	15,000/-
Total :		1,52,15,000/-

Benefits derived in the shape of leaf-fodder, thatching material, fencing material, slates and medicinal herbs is in addition to the above. Forest Department is also undertaking the work of resin extraction from Civil, Soyam and Panchayati forests, the revenue of which is ploughed back for the welfare of the community. Only in Tehri Circle, about 2,500 quintals of Resin worth Rs. 4,50,000/-, is extracted by the Forest Department from the areas outside Reserved Forests, annually. The main problem is of making the hill people conscious of the benefits they are deriving from the forests and making them realise that whatever restriction is imposed by the Government it is done in the interest of conservation of the forests so that these benefits may be derived in perpetuity.

Eucalyptus and the Environment

R.D. GAUR*

Eucalyptus — Comprising of over 600 spp is a handsome evergreen tree of Australian origin. In our country, plantation of this plant received much attraction from the public and other professional cultivators, in many ways. It has a fast growing capacity and can be harvested within a period of 5-10 years. The tree is utilized for paper pulp and essential oil.

But, as far as its relation with the environment is concerned there is little knowledge among the cultivators. Large number of exotic plants have shown good results, however, it should not be treated equally to all exotic species. Before cultivating or accepting any foreign plant other scientific aspects related with the ecosystem should also be taken into consideration. Only superficial economic value of the plant does not justify its introduction on a large scale but it should be understood properly with broad based principles of ecology. The following brief observation and account related with the plant, do not allow it, to be propagated on a large scale, particularly with afforestation programmes.

Chemically every part of *Eucalyptus* contains large number of secondary compounds, particularly essential oil (Penfold and Willis 1961) and phenols including tannins (Hillis 1966). Most of the scientific reports show that these compounds adversely affect the grazer including wild insects and animals. (Feeny 1970, Levin 1971, Rodriguez *et al* 1976).

Its long cylindrical, smooth, glistening bare stem does not provide any camouflage to wild animals and birds. Leaves being leathery, thick and highly aromatic with bitter taste are also not used by insects and other grazers. Inflorescence is visited by only few insects for pollination and its viscid fluid.

Micro organisms which play important role in maintaining the soil, due to the specific chemical odour and harvesting of *Eucalyptus* in short duration it gradually decreases in the soil. This results in poor infertile soil strata, for the successive following vegetations.

Defoliation in the plant is generally reported to be 3-10% (Bray 1964, Elton 1966, Matton and Addy 1975). Leaves due to their obnoxious odour do not attract the insects and micro-organisms in appreciable numbers to decompose it into humus. Consequently leaves are washed away with rains and there is no gain or return to the soil.

The prompt growth of *Eucalyptus* is related with its nutritional requirement including water from the soil. Therefore, it has the capacity to absorb good quantities of food materials from the deep soil in very short period, which ultimately decreases the soil fertility and

water holding capacity and turns the soil almost dry which results in imbalancing of the soil system.

An efficient forest ecosystem has a triple storied canopy consisting of herbs at the ground level, bushes and small trees in the middle and tall trees forming the upper storey, but beneath this tree when developed in forests, there is poor representation of ground and middle storey. It has little social association with other plants, epiphytes and climbers are not at all adjusted with this plant, shrubs and herbs also have the tendency to loose their heritage in social association after some period. Thus it forms almost a homogenous canopy which is not good for a balanced ecosystem and the immediate effects are related with interception of rains, protection of soil from erosion and ultimately changes in other factors.

The Eucalyptus is a amphiphilous plant with wind and insect pollination, large number of pollen grains are produced from this plant and their abundance in the air is reported by many authors. They are said to be casual organisms in allergy particularly dermatitis.

Forests are the natural producers of pure air but can an obnoxious plant like *Eucalyptus* release pure air? In hot weather its leaves evaporate large quantities of essential oil in the atmosphere causing adulteration in the air, which is to be utilized by all the living beings. Naturally, we could not expect even innocuous or free from pollutant atmospheric system from this plant. Recently, a tragic phenomenon of "leaping fire" was experienced in Australia. The volatile oil evaporating from the leaves during hot summer burst into flames causing damage to life and property in a large area.

Thus it has the properties like incapability to restore soil fertility and maintainance of soil micro-organism, poor phyto-social affiliation, obnoxious and repelling nature for animals and insects, cause of pollution to soil and air and allergic in nature. Therefore; only based on short term 'gain' replacement of this plant instead of other good evergreen forest plants is very alarming and in future we may face more and difficulties in our prosperous nature.

The author is thankful to Dr. A.N. Purohit Head of Botany department, Garhwal University, Srinagar for some important discussions.

References

- | | |
|------------------|--|
| Bray, R. 1964 | Primary consumption in three forest Canopies. Ecology 45,165-167. |
| Elton, L.S. 1966 | The pattern of animal Communities 432 London Methuen. |
| Feeny, P. 1970 | Seasonal changes in oak leaf tannins and nutrient as a cause of spring feeding by winter with caterpillars. Ecology 51 :565-581. |
| Hillis, W.E. | Polyphenols in the leaves of Eucalyptus L'Herit' I Achemotaxonomic Survey Photochemistry 5 :1075-1090. |

- Levin, D.A. 1971 Plant Phenolies : an ecological perspective. Amer. Natur. 105: 157-181.
- Mattson, W.J., Addy, N.D. : 1975 Phytophagous insects as regulators of forest primary production Sciencee 190 : 515-522.
- Penfold, A.R., Willis, T.L. 1961 The eucalyptus. 551 : Inter Science.
- Rodriguez, J.G Kmp, T.R., Dabrowski, Z.T. 1976 Behanoir of *Tetranychus urticae* towards essential oils mixture from strawberry foliage. J. Chem. Ecol. 2 : 221-230.
- Soo Hoo, C.F, Fraenkel, G. 1966 The selection of foods plants in a polyphagous insects, *Prodenia eridania* (Gamer). J. insect phyrul 12:693-707.

Biography of a Tiger

COL. SHERJUNG

I am a tigress from North-Indian forests and my name is Sundary. I don't have many days to live—not because I am old. Death in old age is a normal thing, as normal as a day changing into night or a flower making way for a bud. My tragedy is that I am dying in my youth for I have barely reached the tenth year of my life. In normal circumstances, I might have expected to live for nearly thirty years, but now my days are over. The light is about to be snuffed out of my 'eyes', and the night deep and eternal will to be gathered soon.

Some three years ago a cowardly creature shot me from a tree and damaged my shoulder. It was an ugly wound that I received, and it was out of reach for my tongue to lick it clean and keep it protected. Soon it began to fester and crawl with maggots. Only by remaining plunged in a shallow pond and keeping the wound plastered with mud, I was able to get rid of those horrible maggots which fattened on my flesh for months together. It was a torture to be nibbled in the wound day and night, and the pangs of hunger didn't make it any easier.

In the course of time the wound got healed but left behind its permanent effects: it drained off my strength and made me a cripple for the rest of my days. Mentally too, it affected me badly: from an affectionate, even-tempered girl I became nasty and ferocious, filled with wrath and hatred.

For the last three years, somehow, I have been dragging my miserable existence, but now I have reached the end of my tether. Since yesterday I am stricken with paralysis. I can neither stand nor move about; I cannot even shift my limbs. Consequently, there is no chance whatsoever, of getting either a morsel of food or a drop of water.

Soon the vultures will gather around me and, taking advantage of my helplessness, they will tear me to shreds and gobble me up alive—and you cannot blame the vultures for it. They are the "Conservancy staff" of nature charged with keeping the forests clean. A motionless body is a carcass for them and the disposal of carcasses is their prime concern. See, they are already circling in the sky, some of them even alighting on the surrounding trees.

Ah, cruel man! Why does he have to condemn me to die inch by inch and day by day, prolonging the process for interminable years? And yet it is I who am called 'cruel', a killer and what not. What a travesty of truth! I kill because nature made me carnivorous. I kill for living and not for amusement. And when I kill, I do it swiftly, painlessly and with such efficiency that the victim hardly ever knows what is happening to him. Moreover, I

generally kill old and sick animals (they are less difficult to catch) which have no more utility left for either perpetuating the race or protecting the herd. And I don't kill wantonly, never more than absolutely necessary to keep me alive. And I never waste a morsel of food. Can you say the same thing about man?

The difference in food habits and table manners should not entitle anyone to condemn others. And it behoves no one to be cruel and inflict pain with studied indifference. No-one does it, not in the animal world, none at all, believe me! This is the prerogative only of man.

My last moments are approaching fast and every moment, like a movie film is flashing across my mind the events of my entire life. Some of the events look bright and sharp, others dim and hazy, and all, like frightened birds, are crowded on the rim of my darkened horizon. Let me sort them out a bit and try to arrange them in a coherent story:

I was born in a cavern discreetly hidden in the foothill forests—not very far from the mighty Himalayas. We were five in the family: two brothers, two sisters including me and, of course, our mother. I have never seen my father; he had left long before we were born. Once or twice he did try to visit our nursery, but mother, as she told us afterwards, violently remonstrated with him and unceremoniously drove him away. Had he discovered our presence, mother said, he would have surely eaten up the whole lot of us. That's what most of the male tigers do—fathers or no father. Isn't it horrible? But what else can they do? They are mostly hungry and nature uses their hunger to keep the population under control.

Because of this fear, mother was very particular to keep us hidden. She would spare no efforts in concealing our nursery and would take us, every now and then, to a different hiding place—the hollow of a tree, a clump of reeds, a thick bushlet, or a deserted den. She would carry us, one by one by the scruff of our necks holding us gently between her teeth.

Poor mother! She must have had a rotten time of it. Fearing intruders she wouldn't leave us alone for any length of time and consequently, couldn't have secured any decent meal for herself. She must have been almost starving all those days and, for that matter, I doubt if she had any better luck for a good many days even prior to our birth. Her delicate condition couldn't have been exactly ideal for hard work and without working hard—really very hard—it is rarely possible to catch any game.

And yet she was never impatient with us. Even in her prolonged famished condition, she never neglected us and readily suffered our four tormenting months—ever hungry, ever demanding—tugging at her teats.

Soon the needs of our growing bodies out stripped her milk supply. She decided to supplement our diet with meat and set about arranging for it. She would go out for increasingly longer periods and scout around in search of the needed commodity: a hunk of beef, pork, or venison even from a rotting carcass.

We would stay put hiding in her absence and wait eagerly for the food she promised to bring. If she came empty-handed we would immediately know it. She would slink in quietly and lay herself down offering us her teasts in complete silence. But when she came loaded with food she would walk in sprintingly, purring aloud to gladden our hearts. She would nudge us, one by one, in a playful mood and roll us over in a simulated fight.

When this "exercise"—a bit too hard and sometimes too long for our taste had driven us almost mad with hunger, only then she would serve dinner. The dinner would consist of big chunks of flesh she had previously swallowed and regurgitated now after rendering them soft in the juices of her stomach. How clever of her! In one operation she had achieved two objectives; namely, she had simplified the problem of lugging the load; and she had converted the raw meat into a predigested meal.

By this time we were over a month in age and big enough to toddle along with mother. At first we were not quite steady on our feet and walking any distance would tire us out. But before long, we mustered enough strength to follow mother, not only in her night-long prowlings but also in hunting. Rather quick work, you would say; wouldn't you? But it has to be, if the mother and the babies have to survive.

No tigress can afford to be tied down for long to her 'maternity ward'. And no cub, for that matter, can remain for long an encumbrance to his mother. The mother has got to be up and doing soon in order to provide for herself and her babies. She has no savings to fall back upon and no pantry to rummage through. And again, she has no baby-sister to help her out and no assistant to arrange for food. She has to exert herself for every single meal, irrespective of whether she is physically fit for not.

But all this worry was for poor mother alone and none for us—four fluffy balls of fun and frolic. Fluffy, I said, because the long and soft fur covering us from head to foot justifies the word. It was really ridiculous to be born with woollen paddings in tropical country like India—and, mind you, we were born in the month of April.

Except the minor discomfort of our fur, life, on the whole, was happy for us. We used to spend the whole day either in playing or sleeping, and mother was always around to feed us whenever we felt hungry. No one dared to approach us and threaten our lives in her presence and, in her absence, we were trained never to stir out from our protected shelter. Mother was always extremely kind and considerate to us, and she was also a very clever

teacher. She believed in 'teaching without tears' and consequently, our training was thoughtfully geared to exciting games and pleasant excursions.

By the time we were six months old, we had already acquired the rudiments of jungle-craft. We knew how to conceal ourselves, how to stalk and ambush, how to attack and grab, and how to deliver and parry a blow. We also knew how to use the land, the shade and cover, and the currents of the wind to the best of our advantage. All this and other principles of our discipline, we learnt while playing some interesting game like hide-and-seek, catch-as-catch-can, or blindman's buff. We just played and played, happy and 'hilarious, without ever knowing that we were being put through a rigorous course of training.

And just at that time when life was getting more and more interesting a tragedy overtook the family. In those days we were living in a rocky crevice and had already spent nearly a month in it. Rather a long period to stay in one place which normally mother never liked. Apart from being security-conscious, she had an aversion to dirt and filth. The slightest filth in our dwelling place and out would we be driven to a new abode. But we stuck to that crevice because mother had secured one after the other, two splendid 'kills'—a *Sambhar* and a pig—in a nearby thicket. It wasn't every day that luck favoured us so magnanimously; and we hated to be ungrateful by refusing such a feast.

Night after night we would return to the dinner carefully secured in the bushes against thieves like crows, vultures, jackals and hyenas. We were hardly half through the second 'kill' when suddenly, my sister, Mohini, was taken ill. She started with pimples on her belly, developed painful spasms with nose and mouth running, and ended with a paralytic stroke which killed her within a week. She suffered cruelly and died in agony.

Poor Mohini was a delicate child, smart and winsome. Her death was a great blow to our mother who loved her most. Mohini died, it appeared, of a known disease which is responsible for killing a large number of weaning and growing cubs. The main cause of Mohini's ailment and death, according to mother, was the long stay in that filthy crevice. She immediately shifted us to a new place, two nights' trek away, down in a grassy jungle.

Misfortune did not stop with a single stroke; it dealt another one in quick succession. And this time it fell on my little brother, Raju. He was an obstinate boy, a bit of a spoilt child, and given to playing truant. Soon after we took abode in the grassy jungle, one afternoon, the forest caught fire and went up in a roaring blaze. It was a frightening sight; the wild flames, riding on a gusty wind, were racing and lapping up the sky with their flickering long tongues. Mother came rushing and hustled us out of the clump we were hiding in, stiff with fright and dumb with anxiety. We dashed across the threatening space and gained the nearest open spot. We found to our dismay that Raju was missing. The silly boy must have gone out to play on his own while we were asleep. Mother roared her summoning call, over and over again, but there was no response from Raju.

Tigers in the Wild

A great stampede of animals, chased by the roaring flames, shook the ground. But none drove out our little Raju. We waited and waited till the whirling smoke and the flying sparks cascaded around us and the approaching flames drove us away. We never saw our Raju again. He never came back. And still, for days on end, mother kept on howling—ever more poignantly, ever more urgently—calling him back. All in vain. The prodigal son never returned. He surely got caught in the wild-fire and most certainly was burnt alive.

These are hazards of jungle life, created, not infrequently, by human hands. The man, who casually flicks off a lighted cigarette or a match stick, could cause a havoc in the forest, the enormity of which would make, even a hardened criminal shudder in horror. Imagine the destruction, not only of beautiful trees and other vegetation, but also of thousands of innocent lives: birds and animals, eggs and chicks, babes and mothers, the young and the old—all and every thing. They are roasted alive and reduced to ashes. Isn't it criminal?

After losing Raju in the flames we wandered, like banished souls, in the wilds, never stopping in one place longer than necessary to procure a meal. It was an odyssey of despair, which after a struggle of three long months, found us in Tarai forests, close to the Nepal border.

We liked this place—a large tract of undulating land, thickly covered with Sal trees and generously stocked with game and water. It was just the place we needed and we settled down there to an undisturbed life. The food problem wasn't very acute and yet with our growing bodies the amount of food we needed was growing day by day. We were just over a year in age, Bhola, my brother, weighing nearly 200 pounds and I some twenty pounds less. We needed among the three of us, not less than 110-130 pounds of solid meat every day: 50-60 pounds for mother alone and 30-35 pounds for each of us.

It was a job to secure that much of food and we couldn't do it every day. On the average we would catch a prey twice a week, eat it out in a day or two (depending on the size of the prey), and starve for the rest of the time. The gap between two square meals could sometimes be painfully long—as long as ten days. But whenever we could, we would gorge ourselves to the bursting point and make up for the lean days.

Can you imagine how much a full grown, hungry tiger can eat? He can readily devour of a buffalo's hindquarters weighing 350-400 pounds in a single hight. I have seen my own mother doing it many a time, and I did myself before I was wounded. A prodigious amount of food to tuck in! Isn't it?

The mounting pressure of demand and supply goaded both of us the brother and the sister, to extend a helping hand to mother. It wasn't very much; only limited to driving the animals in her direction. We would go slinking around the flanks of the intended victim

and appear suddenly at his rear to frighten him into rushing towards the spot where mother would be lying in ambush for him.

Even this simple job we couldn't perform properly until mother taught us the method. The prey, we learnt, must not be approached from the side the wind is blowing. Most animals, wild or domestic, have a keen sense of smell and they generally graze facing the in-coming wind. It enables them to catch the scent of the approaching danger from a long distance even though the intervening cover may be keeping it out of sight.

We also learnt that to make a successful stalk one must never smell high, for instance, of putrid flesh or blood. One should always keep clean and free of odour. That's why all the cats, big or small, spend most of their time in grooming and licking themselves clean.

Once or twice we did catch a deer on our own, but made a horrible mess of it. In place of killing outright we went on mangling the wretched creature. Mother had to intervene to put and end to his agony. She felt very bad at our clumsiness and started training us in making a neat job of it.

She would anchor an animal by crippling his legs and set us on him. We would then be guided to bite through his throat and sever the jugular veins. Nowhere else she would permit the first bite, nor would she allow the use of paws in dealing blows. Should the victim happen to be a big animal—a gaur or a huge buffalo—she would make us bite off the hamstrings prior to tackling its throat. We learnt from these "practical lessons" that self-protection, the economic use of force and a lightening stroke were the three essentials of successful hunting.

(To be continued)

From his forthcoming book

By courtesy

Tigers in the Wild

THEIR DISTRIBUTION AND HABITAT PREFERENCES

By

KAILASH SANKHALA*

Abstract

The tiger (*Panthera tigris tigris* Linn. 1758) is the 'spirit' of the Indian Jungle. The study deals with the population and distribution of this 'spirit' in the diversified ecosystems of the sub-continent of India. It covers a wide range of habitat types varying from the tropical wet evergreen forests to dry deciduous thorn forests, and from the tropical submontane forests to the saline swamps of Sunderban delta. In general, 70% of the tiger population is found in the moist deciduous forests and the dry deciduous forests. Presence of primary prey species Gaur, wild boar, sambar and chital, competitor wild dog and copredators leopards and jackals associated with the tiger have also been evaluated with the help of animal numbers in each of the Reserves which have been subjected to almost a uniform system of management under the Project Tiger.

According to the study, the best habitat type for the primary prey species like the wild boar in the moist deciduous forests of Palamau (with a density of 1940 animals to 100 sq. km.) and for the sambar, the dry deciduous forests of Ranthambhor where 1044 animals to 100 sq. km. are found. The chital is distributed throughout the habitat of the tiger but its highest concentration is in moist deciduous forests of Palamau (2176/100 km²), the Himalayan foothills (1750/100 km²), and the central highlands Kanha (1506/100 km²) are the second and the third best habitats respectively. Interestingly, the tigers do not follow the pattern of distribution of the prey populations nor do they exhibit preference for convenient climate or even easy topography for their high population density. For the tiger, the Himalayan foothills (Corbett Reserve) and wetland savannah ecosystem (Kaziranga and Dudwa Reserves) which support 14.00, 11.62, 10.20 tiger per 100 sq. km. respectively appear to be the best habitat of the tiger. Next best habitats are even the seemingly hostile ones which are ecologically considered critical ecosystems—(i) the deltaic slushy Sunderbans with 7.7 tigers and (ii) the dry hot open forest of Ranthambhor Reserve characterised by extremely hot summer and scarcity of water with 6.33 tigers to every 100 sq. km. Closely

Paper read at the International Symposium on the Indian Tiger—*Panthera tigris tigris* (Linn. 1758) Leipzig (G.D.R.) October 11 and 12, 1978. (Reprinted by courtesy)

*Former Director, Delhi Zoological Park and also first Executive Director, Project Tiger, India, and presently Chief Wildlife Warden, Rajasthan, Jaipur, India.

follows the Kanha Reserve of the Central highlands, with all favourable conditions of topography, climate, cover and food, where 6.02 tigers per 100 sq. km. are found. In the seemingly ideal habitat of moist deciduous forests of Simlipal in the Eastern Ghats, Palamau of the Chhota Nagpur and Bandipur in the Western Ghats, with plenty of food, cover and water, tigers are thinly distributed. Their respective densities are 2.32, 3.45, 3.76 tigers per 100 sq. km. One obvious reason for low population in prey-rich and congenial habitats appears to be stiff competition with acute competitors e.g., wild dogs (*Cuon alpinus*) who are more efficient and effective team predators on the food range of the tiger.

Introduction

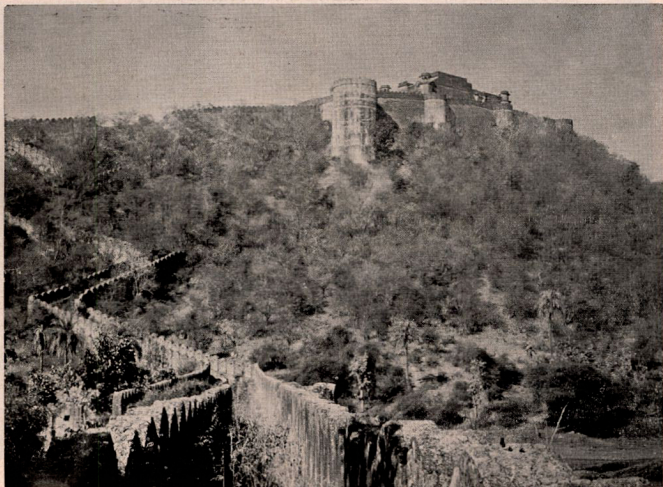
The tiger (*Panthera tigris tigris* Linn. 1758) is a vital factor in keeping the good health of the prey species to ensure high environmental quality of the habitat. It also helps to maintain the balance of nature. The tiger's hypnotic charm makes the species a 'spirit' of the Jungle. This 'spirit' is widely distributed in the forests of India from the wet evergreen to the dry deciduous forests varying in geography, climate, vegetative composition and complex wildlife, specially the primary predators and prey species in habitat diversity.

The observations of the present study, relating to the country-wide count of the tigers, and the animal numbers of the representative ecotypes, particularly the Tiger Reserves which have been returned to their almost natural state, are based on the meagre data available with the author collected during the period he was a Jawaharlal Nehru Fellow* as also during the period he was associated with the Project Tiger**. Though it would be fallacious to derive long term ecological conclusions on the basis of the scant information collected by different methods and obtained from samples which can hardly stand strict statistical analysis, it would be equally erroneous to depend too much on statistics and ignore obvious biological facts in a live science like wildlife ecology.

The present study could be meaningfully and fruitfully undertaken solely because the tiger has received total protection throughout the country all through the decade. The ban on shooting of tiger since 1970, the enactment of a special legislation, The Wildlife Protection Act, 1972, which gave the needed legal protection to the species, and a nationwide exercise to count tigers during 1972, created a national consciousness for preservation of the species. Launching of a massive conservation effort, the Project Tiger, in 1973, the first for six years in nine widely different ecosystems, and extended for another similar term with two additional Reserves, helped the species of the tiger to multiply. The present decade is, therefore, a period of positive conservation endeavour. My study covers this

*The Fellowship was awarded to study ecology and behaviour of the Indian Tiger for two years, 1970-72 on the recommendation of the Wildlife Preservation Society of India.

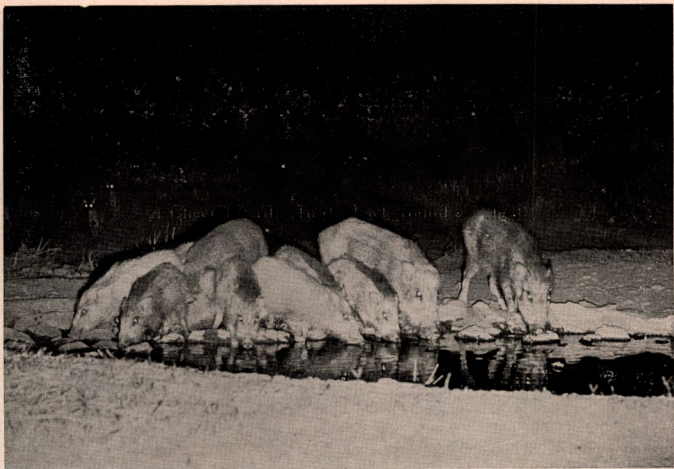
**The author was the first Executive Director of the Project Tiger, India—a massive effort to save the tiger from extinction, till 1977.



Dry Deciduous Thor Forests of Sariska—Kankwadi.



Langur, four horned antelope—a male and female arriving to drink.



Wildboars in Dry Deciduous Forests.



A Cheetal herd. In the background a Nilgai.

salubrious period. It is truly the decade of the tiger which undeniably has brought, so to say, 'a smile on the face of the tiger'.

Ecosystems

Vegetative biomass is a resultant of interaction between climate, soil and topography. It is also influenced by biotic factors. These parameters have been taken into consideration by Champion and Seth (1968) while classifying the forest type of India as follows:

- (1) Tropical Wet Evergreen;
- (2) Tropical Semi-Evergreen;
- (3) a. Tropical Moist Deciduous;
b. Swamps. Freshwater, Terai;
c. Swamps: Littoral, Sunderbans.
- (4) Tropical Dry Deciduous;
- (5) Tropical Thorn Forests;
- (6) Sub-montane Sub-Tropical;
- (7) Temperate and Cold Desert.

Distribution of Tigers

The first estimate of the population of tigers in India was made by Jim Corbett in the fifties when he fixed the population figure as 2000 (Corbett 1955). It was followed by E.P. Gee in 1964 when tiger population of India was considered to be 4000 (Gee 1964). My speculation of the population of tiger in 1969 (Sankhala 1970) was 2500-3000. Though the figures were based on State-wise details, it lacked the support of field work. This gap was filled during my JAWAHARLAL NEHRU FELLOWSHIP period by my visiting even the smallest unit of the tiger habitat to collect information about the presence of tigers. In 1972 a massive exercise was undertaken by the Forest Departments to count tigers of India. Every possible evidence of the presence of the tiger was collected. Thousands of tracing pugmarks (footprints), kill counts and sighting evidences were gathered (Project Tiger 1972) and an estimate was made of the number of tigers. It was said to be 1827. With the figures of the 1972 country-wide census plus my own study of the distribution of the tiger, an attempt has been made to understand the distribution pattern of the Indian Tiger. Numbers plotted on a map of the Indian sub-continent show approximately the number of

tigers in that habitat. This is based on Table I, which presents tiger numbers as per our 'least count' localities which could possibly be marked on the map. These census figures are only approximate numbers and express only relative proportions. Table I follows:

Table I*Distribution Of Tigers Statewise*

(To be read with the map of the Indian Subcontinent)

Figures show number of tigers; (Brackets show latest report)

A — ARUNACHAL :

Kameng	...	18
Banderwa	...	3
Siang	...	6
Pasighat	...	14
Lohit	...	14
Tirap	...	14
		69

B — ASSAM :

Manas	...	21	(105)
West Assam	...		
(Bansbari)	...	10	
North Kamrup	...	22	
Darrang	...	25	
Sibsagar	...		
(Kaziranga)	...	29	(50)
Lakhimpur	...	26	
Digboi	...	4	
Dibrugarh	...	5	
Sibsagar	...		
(Golaghat)	...	8	
Mikir Hills	...	4	
Nowgong	...	10	
South Kamrup	...	3	
		167	

C — NAGALAND :

Mon	...	34
Mokok Chunk	...	39
Intaki	...	7
		80

D — MEGHALAYA

Jowoi	...	3
Khasi	...	18
Garo Hills	...	11
		32

E — MANIPUR :

Manipur	...	1

F — MIZORAM

Mizoram	...	5

G — TRIPURA :

Tripura	...	7	(15)
---------	-----	---	------

H — BANGLADESH :

Sunderbans	...	100
------------	-----	-----

J — WEST BENGAL :

Sunderbans	...	151	(181)
North Bengal	...	53	
		204	

K — BIHAR :

Champaran	...	14	
Shahabad	...	2	
Betla-Palamau	...	41	(50)
Gaya	...	4	
Hazaribagh	...	13	
Ranchi	...	2	
Singhbhum	...	9	
		85	

L — ORISSA :

Bonaigarh	}	...	3	
Deogarh				
Atagarh		...	3	
Simlipal	}	...	13	(60)
Bariapada				
Karanjia		...	16	
Nayagarh		...	2	
Sundargarh		...	4	
Phulbani		...	8	
Baliguda		...	10	
Puri		...	5	
Raigoda		...	5	
Nowrangpur		...	7	
Bannmira		...	7	
Angul		...	7	
Kalahan-di		...	12	
Ganjam		...	11	
R. Udayagiri		...	9	
Jeypore		...	13	
Khariara		...	7	
			142	

M — ANDHRA PRADESH :

E. Godavari	...	6	
Warangal	...	13	
Khammam	...	3	
Bhadrachalam	—		
Nagarkurnool	...	5	
Adilabad	...	6	
		33	

N — TAMILNADU :

Madhumalai	}	...	8	
Nilgiri Hills				
Madurai		...	7	
Sirivilturipur		...	12	
Mudon Thorai		...	29	
(Tirunelveli)				

O — KERALA :

Trivendrum	...	7	
Thenmala (Ranni)	...	10	
Periyar	...	14	
Chakudy	...	8	
Palghat	...	4	
Kozhikode	...	12	
Wyanad	...	5	
		60	

P — MYSORE (Karnatak) :

Mysore	...	12	
Chamrajnagar	...	12	
Hursur (Bandipur)	...	10	(48)
Chikmangalur	...	6	
Bhadravati, Sagar	...	19	
Coondapoor	...	7	
Dandeli	...	29	
Karwar	...	7	
		102	

Q — MAHARASHTRA :

Ratnagiri	...	4	
Poona	...	1	
Jalgaon	...	1	
Melghat E.W.	...	44	(57)
Nagpur	...	16	
Bhandara	...	6	
Chanda	...	44	
		44	
		160	

R — MADHYA PRADESH :

Bastar	... 53	} 62	
Kanker	... 9		
Raigarh	... 5		
Raipur	... 28	} 52	
Karboda	... 13		
Rajnandgaon	... 8		
Mahasamund	... 3		
Balaghat	... 27		
Mandla (Kanha)	... 72		(95)
Seoni	... 16		
Chindwara	... 8		
Khargaon	... 4	} 7	
Indore	... 1		
Dhar	... 2		
Hoshangabad	... 14	} 49	
Harda	... 7		
Sohagpur	... 1		
Betul	... 12		
Khandawa	... 15		
Bhopal	... 18	} 34	
Raisen	... 14		
Sagar	... 2		
Guna	... 8	} 26	
Shivpuri	... 4		
Sheopur	... 14		
Chatarpur	... 9		
Panna Siddi	... 3		
Panna	... 12		
Damoh	... 11		
Umaria-Shahdol	... 20		
Sarguja-Bilaspur	... 38		
Siddi	... 3		
Rewa	... 2		
		456	

S — GUJARAT :

Dang ... 8

T — RAJASTHAN :

Chittorgarh	... 12	
Kota-Bundi	... 28	
Ranthambhor	... 11	(22)
Siraska-Alwar	... 14	(11)
Karauli-Dholpur	... 9	
Mount Abu	... 2	
	76	

U — UTTAR PRADESH :

Dehra Dun	... 15	
Saharanpur	... 4	
Lansdowne	... 19	
Kalagarh	... 23	
Corbett Park	... 34	(73)
Almora	... 2	
Bijnor	... 4	
Ramnagar	... 15	
Haldwani	... 24	
Rohilkhand	... 10	
Terai Bhabhar	... 9	
Pilibhit	... 35	
North Kheri	... 33	(50)
South Kheri	... 5	
Gonda	... 5	
Gorakhpur	... 1	
Banda	... 24	

262*

*Now increased to 400 including 73 of Corbett Reserve.

V — NEPAL :

Sukhlaphanta	...	20
Karnala	...	24
Others	...	11
Chitwan	...	25
		80

W — BHUTAN :

Bhutan	...	40
Grand Total :	India	... 1980
	Others	... 420
		2400

- (1) Each State of the Indian Union, Nepal, Bhutan, Bangladesh where tigers are found have been given an alphabet following the clockwise direction starting with Arunachal as A, Tamilnadu as N, Madhya Pradesh as R and Bhutan as W.
- (2) The places where tigers are found have been arranged in clockwise direction starting with 18 of KEMENG and ending with 40 of BHUTAN. Only important places have been mentioned. Smaller places have been grouped together with adjoining important or known place.
- (3) Since 1972, there has been an increase in the tiger population. Known figures have been given in brackets. Overall increase has been 6-8 percent and the tiger population can be safely considered to be 2772 for India and about 3300 for the subcontinent excluding western Burma.
- (4) Increased figures shown are not all from reproduction. Some of them are shifted from adjoining areas.

*

*

*

*

Indication of the status of the tiger in different ecosystems (Forest types) as identified earlier, is given in Table II. Though tigers do not recognise any administrative or political boundaries, Table III gives an assessment of tigers in each State of the Indian Union and also some indication about the neighbouring countries with reference to the forest types. The figures give only broad indications of the potential of the ecosystem. Table II and Table III follow:

Table II
Distribution of tigers according to habitat type

Forest	Habitat area (in million Hec.)	Percentage of the total forest	Population of tigers	Percentage of tigers	Present status
1	2	3	4	5	6
1. (a) Tropical wet evergreen tall trees, dense forest lucious green all the year round.	4.50	5.50	71	3.59	The area is still not much disturbed except places like 'sholas' in Western Ghats. Population and food range poor. Animals—tiger, leopard, elephant, sambar, barking deer, gaur.
2. Tropical semi-evergreen. Same as 1 (a) except that some deciduous trees in top canopy of the forest. Short duration of leafless period.	1.08	1.32	268	13.50	A transition zone between evergreen and moist deciduous forests, disturbed by shifting cultivation. Refuge of those persecuted from moist deciduous. Animals—tiger, leopard, elephant, sambar, chital, gaur, wildboar-Manas.
3. (a) Tropical moist deciduous. Open meadows, wide range of forage vegetation. Deciduous trees dominate in the top canopy. Longer leafless period.	23.3	28.498	810	40.91	Good cover, water and wide range of prey population. Extensively managed forests, grazing pressure increasing. Needs immediate attention. Animals—tiger, leopard, elephant, sambar, chital, gaur (absent in U.P.) wildboar, wild buffalo (localised), nilgai on outskirts, swamp deer.

1	2	3	4	5	6
3. (b) Fresh water swamps. Localised impenetrable thickets of cane. Dries during summer, excellent grass lands.	0.65	0.80	63	3.18	Swamps, extensively drained and cultivated, large area almost lost, area further being depleted by drainage and plantation. Animals—tiger, leopard, swamp deer, hogdeer, wild buffalo; black buck and nilgai on extreme fringes, wildboar.
3. (c) Littoral swamps, tidal marsh, thick cover.	0.01	0.012	151	7.66	Disturbed by woodcutters and honey collectors, poor range of prey limited only to wildboar and chital. No freshwater. Hot and humid. Animals—tiger, chital, wildboar, monkey Rhesus, crocodile, sharks. Sunderbans.
4. Dry deciduous extensive tracts open and leafless for greater part of the year. Excellent fodder and browse.	29.15	35.65	596	30.10	Heavily populated and overgrazed by domestic cattle, water scarce, uncertain, unequally distributed rainfall. Animals—tiger, leopard, sambar, chital, nilgai, chausingha, chinkara, black buck, wildboar, barking deer in some parts, hogdeer in northern parts. Ranthambhor, Siraska.

1	2	3	4	5	6
5. Tropical thorn forests. Open stunted, sparse vegetation.	5.24	6.40	8	0.40	Scanty rainfall, overgrazed, poor cover and scarce water, large sandy tracts and terrain hilly. The tiger visits during winters, straying for food. Animals-leopard, nilgai, chital, black buck, chinkara, wildboar.
6. Montane subtropical. Precipitous topography, thick cover, evergreen vegetation.	10.29	15.585	13	0.66	Extremely limited trees, scattered hills. Tigers remain only as transitory. Extensively disturbed by cultivation of coffee and tea. Sambar, wildboar, Goral in the Himalayas, Nilgiri, Tahv in the south, wildboar and sambar in Mount Abu.
7. Temperate and cold desert. Hot included. No tiger habitat.	7.54	9.22	Nil	Nil	Difficult terrain, no food for tigers and therefore no tiger except occasionally stray one following some sheep herd or mules of shepherds.
Total :	81.86	100.00	1986	100	

Table III

DISTRIBUTION OF TIGERS IN THE INDIAN SUB-CONTINENT: INDIA, NEPAL, BHUTAN, BANGLADESH—As assessed in 1972 (Sankhala)

(The distribution is only indicative assessment as census was not conducted throughout the country due to early rains.)

Region	State	Wet ever-green	Semi ever-green	Moist deciduous	Fresh swamps	Dry deciduous	Thorn forest	Littoral swamps	Sub-montane hills	Total
		a	a	b	b	c	c	d	e	
1	2	3	4	5	6	7	8	9	10	11
I—EASTERN :										
	I—Arunachal	20	36		4				9	69
	Assam		49	89	29					167
	Nagaland	26	54							80
	Manipur		1							1
	Meghalaya		32							32
	Mizoram	5	2							7
	Tripura		7							7
	West Bengal		30	23						53
Total :										
	India	51	211	112	33				9	416
	Bhutan	20	20							40
Total of I:—		71	231	112	33				9	456
II—NORTHERN :										
	Bihar				14					14
	Uttar Pradesh			218	16	4				238
	Nepal			55	25					80
Total of II :				273	55	4				332

1	2	3	4	5	6	7	8	9	10	11
III—WESTERN										
Rajasthan						66	8		2	76
Madhya Pradesh						33				33
Uttar Pradesh						24				24
Total of III :						125	8		2	133
IV—CENTRAL :										
Bihar				64		7				71
Orissa				112		30				142
Madhya Pradesh				150		273				425
Maharashtra				40		120				160
Andhra				19		14				33
Gujarat						8				8
Total of IV :				365		453				838
V—SOUTHERN :										
Mysore (Karnatak)			5	80		17				102
Tamil Nadu			12	15					2	29
Kearla	20		40							60
Total of V :	20		57	95		17			2	191
VI—SWAMPS :										
Sunderbans (India)								151		151
Bangla Desh								300		300
Total of VI :								451		451
Grand Total										
I to VI	91		288	865		88	599	8	451	2400
India alone	71		268	810		63	599	8	151	1980
Percentage	3.59		13.53	40.91		3.17	30.1	0.40	7.63	100

The distribution pattern of tigers shows that the moist deciduous forests support over 40% of the present tiger population. The dry deciduous ecosystems where 30% of the tigers live is the second best habitat. Over 70% of the population of the tiger is held by these two ecosystems which extend over 60% of the tiger habitat of India. But this pattern cannot be considered as a natural one as these ecosystems are highly influenced by artificial biotic factors. The pattern also shows erroneous densities of tigers. According to the Table II, the best habitat of the tiger is the delta of Sunderbans where 151 tigers were reported to be living in 0.01 million hectares. This is not true as per assessment made in the latter part of this study.

The Tigerland of India can also be classified into four main geographical regions:—

- (i) The Himalayan foothills and Terai including Kumaon hills, Siwaliks (Corbett Reserve) and the Doons characterised by valley and low hills formed by geological upheaval resulting in rising of the whole river system of the plains and the bouldery 'Bhabhar' formed in the recent past by erosion of the conglomerate hills. The adjoining plains which becomes marshy during rains due to quick seepage of water in 'Bhabhar' and emerging on surface in plains parts of Uttar Pradesh (Dudwa), Bihar and Sukhlafanta, Karnali and Chitewan of Nepal.
- (ii) Eastern Himalayas including the foothills (Manas Reserve), eastern plains, riverine islands, wet savannah and plateau. The topography varies from the precipitous Himalayas in Bhutan, Arunachal Pradesh, Assam, Nagaland and Meghalaya to the wide open and closed valleys of Assam, wet savannah on the Brahmaputra banks (Kaziranga Reserve), riverine islands including Manipur plains, and plateau of Shillong.
- (iii) The delta of the Sunderbans with thick vegetative mass, steaming hot climate and slushy ground (Sunderban Reserve).
- (iv) Indian peninsula with 17 sub-ecosystems including the Aravallies (Saraska), Vindhya (Ranthambhor), Malwa, Deccan (Melaghat), Chhota Nagpur (Palamau), Rewa plateau, Eastern Ghats (Simplipal), Baghelkhand, Central highlands (Kanha), Chatisgarh, Western Ghats (Bandipur and Periyar). It covers hills, plateaus and valleys. It has the most complex geology, geography and biomass. It is also the largest in size and holds the maximum number of tigers and eight out of eleven Tiger Reserves (mentioned in brackets) of India.

Assessment:

Wildlife Potential:

Diversity of habitat of the tiger and the factors influencing distribution and numbers of the wild animals have been so varied that it was not possible to qualify and compare

Table IV

Sanctuary/ Reserve	Year of estimate	Area in Sq.Kms	Number of species									
			Swamp deer	Sambar	Chital	Wild boar	Gaur	Nil- gai	Ele- phant	Leo- pard	Wild dogs	Tiger
1. Manas	1976	2840	X	C	R	A	P	X	X	C	P	105
2. Kaziranga	1974	430	250	200	X	700	X	X	430	12	X	50
3. Palamau	1977	928	X	900	20200	18000	600	100	35	60	80	35
4. Simlipal	1976	2750	X	A	R	A	C	X	C	C	C	60
5. Sunderbans	1976	2585	X	X	10000	1813	X	X	X	X	X	181
6. Corbett Park	1976	525	X	C	9100	3200	X	P	115	35	R	73
7. Dudwa	1976	490	2000	C	2000	A	X	P	25	7	X	50
8. Ranthambor	1978	300	X	3100	3290	1835	X	1569	X	27	X	19
9. Sariska	1978	479	X	800	700	A	X	900	X	10	X	11
10. Kanha	1977	930	300	1300	14750	2349	650	P	X	35	54	56
11. Melaghat	1976	1570	X	C	X	A	C	X	X	C	P	57
12. Bandipur	1976	690	X	302	1834	284	X	307	1187	29	149	26

For comparison, the animal populations have been uniformly reduced to a unit area of 100 sq. kms. in Table V which is a sizeable area to be home range of a few predators and a self contained eco-unit for principal prey animals.

Table V
(Animal population as reduced to 100-sq.Kms)

Sanctuary/ Reserve	Number of species									
	Swamp deer	Sambar	Chital	Wild boar	Gaur	Nilgai	Elephant	Leopard	Wild dogs	Tiger
*1. Manas	P	C	R	A	P	X	X	C	P	3.72
2. Kaziranga	38	46	X	163	4.0	X	100	2.8	X	11.62
*3. Palamau	X	97	2170	1940	64.6	11.8	3.8	6.5	8	3.45
*4. Simlipal	X	C	R	A	C	X	C	C	C	2.32
*5. Sunderbans	X	X	336	70	X	X	X	X	X	7.70
*6. Corbett Park	X	C	1750	1576	X	P	22.1	6.7	R	14.00
7. Dudwa	208	C	408	A	X	P	5.1	1.4	X	10.20
*8. Ranthambhor	X	1044	1096	611.6	X	523	X	9.0	X	6.33
*9. Sariska	X	167	140	FNA	X	187	X	2.0	X	2.20
*10. Kanha	32.2	140	1586	253.0	70.0	P	X	3.8	11.8	6.02
*11. Melaghat	X								C	3.63
*12. Bandipur	X	43.7	265	41	44	X	172	4.2	21	3.76

FNA = Figures not available; A = Abundant; C = Common;
P= Present in a few numbers; R = Rare; X = Absence of species.

*= Tiger Reserve.

wildlife productivity of different ecosystems. It is for the first time that a uniform treatment—strict protection and reduction of human interference with biotic factors—has been given to a few selected Reserves distributed in a wide range of ecosystems of the tigerland throughout the country. Elimination of external biotic factors by stopping grazing, forestry felling and other human interference allowed the natural forces to be free to return each of the representative type of the reserve to their nearly natural status. This opportunity has provided a basis to compare the wildlife potential of each of the habitat type and also to understand the habitat preferences of principal primary prey animals and their predators with special reference to the tiger. The data obtained from the systematic population counts conducted in these reserves enables us to understand the optimum habitat condition for the tiger and its principal prey in India.

The population numbers of the principal prey animals and the tiger are presented here in brief:

According to Table IV, the Swamp deer (*Cervus duvauceli*) is now confined to the swamps of north of the Brahmaputra river, Nepal Terai and the Dudwa plains of U.P. There are 2000 heads of swamp deer in Dudwa National Park and over 1000 in Sukhlafanta of Nepal, 250 in Kaziranga and 300 members of a separate race, *Carvus duvauceli brandari*, are found in Kanha.

The highest density of sambar, 10.4 per sq. km., is in Ranthambhor Reserve of the Vindhyan system in peninsular India. Sambar herds are commonly seen during all seasons in Ranthambhor. Concentration of population at waterholes during summer removes all reservations to accept the statement of its richness (114 sambar counted at Rajbag at 7 P.M. on May 23, 1978, and there are 70 waterholes in the Reserve. In the next month 296 were counted on 14 June, 1978 at the same place). Sariska is another dry rocky Aravalli ecosystem which supports 1.6 sambar per sq. km. Sariska has not been able to recover the 1971 disaster when *Haemertigic septiceime* took the toll of over 2000 sambar. This shows that the population of sambar then was 2500, or 5.3 per sq. km. Other habitat types, seemingly favourable, support one or less than one sambar per sq. km. It is absent in the Sunderbans.

The chital (*Axis axis*) is the second common prey animal of the tiger. The presence of chital in Kanha is conspicuous. One can easily count over 3000 chital grazing in meadows of Kanha. But the highest density of species is in Palamau, 21.7 per sq. km., and the second best is in the foothills of the Himalayas in the Corbett Reserve. It is found even in the swamps of the Sunderbans but is conspicuously absent in the high rainfall areas of the eastern region, east of the Manas Reserve, the Eastern Ghats (rare in Simlipal) and the Western Ghats (Periyar) as well as the dry regions of the outer Aravallies, Mount Abu, and the Deccan lava (Melaghat). In Sariska the species is an escape, now established due to

artificial waterholes. Our telemetry studies conducted at Ranthambhor show that the chital is never found more than a kilometre away from a source of water. In years of drought surface water disappears, during summer. The fact that the chital has no capacity to migrate to long distance source of water explains the absence of the chital in the outer Aravallies (Table IV).

The wildboar is well suited to the undulating condition of plateau and mixed miscellaneous forests of Palamau in Chhota Nagpur where its density is over 19.4 animals per sq. km. Its second best habitat appears to be the Himalayan foothills in the Corbett Reserve with 15.7 animals per sq. km. The dry deciduous forests of Ranthambhor support a population of 6.1 per sq. km. and is the third best habitat of the wildboar. The moist sal forests of Kanha in the Maikal hills of the Central Highlands and wet savannah of Kaziranga in the Brahmaputra valley plains support 2.5 and 1.6 animals per sq. km. respectively. In the remaining reserves mentioned in Table V, they are less than one per sq. km. But there is no area in the tigerland where the species is absent.

The Gaur (*Bos gaurus*) is found in the eastern region and throughout the Indian peninsula except in the dry areas of western Maharashtra, Madhya Pradesh, Rajasthan and Gujarat. It is said to reach maximum body size and herd numbers in the eastern side of the Western Ghats (Bandipur-Madhumalai, Krishnan 1975), but our census records of Palamau, Kanha and Bandipur (almost a cross section of the peninsula), presented in Table V, do not support the claim of numbers. Their distribution appears to be in different order, 64.5, 54.0, 44.0 per 100 sq. kms. respectively.

The dry forests (Sariska, Ranthambhor) support high population of the nilgai (*Boselaphus tragocamelus*), a substantial meal for the tiger. The nilgai is confined to the fringes of the moist forests which are dry due to biotic influences. It is absent in heavy rainfall zone.

Hog deer (*Axis porcinus*) is confined to the northern plains. In Kaziranga (430 sq. kms.) there are 6500, and in the Corbett Park nearly 1125.

The langur (*Presbytis entellus*), an arboreal primate, is only occasional prey of the tiger. It is found all over the tigerland except the Sunderbans where the rhesus macaque dominates. The langur population is the highest in the dry deciduous areas. Population estimates of 4578 (1526/100 km.) langurs has been recorded recently (June 1978) in Ranthambhor. The primate population in Kanha is 4616 (384/100 km²), and 1512 (219/100 km.²) in Bandipur in the Western Ghats.

The barking deer (*Muntiacus mufja*), chinkara (*Gazella gazelle*) and the four-horned antelope (*Tetracerus quadricornis*) which are not much of a prey for the tiger but form part of the spectrum of the wildlife of the tigerland. Among wild birds, only the peafowl (*Pavo*

cristatus) is of some significance as a prey of the big cats. The largest concentration of the bird is in Sariska and Ranthambhor regions in Rajasthan. With protection it is showing up in all reserves except the Sunderbans which is not the habitat of the bird.

Even camels have not been out of reach of the tiger. I had an occasion to study a tigress feeding on a camel—the event has been photographed for the first time. The way in which this animal of curious anatomy is tackled by tiger is interesting. Instead of working from the haunches, it starts working from upper part of the thorax of the carcass.

The range of distribution of the buffalo (*Babulus bubalis*) was also wide formerly, but now it is confined to the eastern region (in Kaziranga alone the population is 600, and they are more in Manas), a few in Nepal Terai and a small herd in Indravati valley, Bastar. A problem of their crossing with domestic buffaloes in Kaziranga and Manas has recently cropped up. This is resulting in gene-pollution and degeneration of the wild stock.

Among the large prey animals, the elephant (*Elephas maximus*) and the Great Indian one-horned Rhinoceros (*Rhinoceros unicornis*) are the large ones, but are not commonly preyed upon by the tiger. Occasionally, only their calves are killed. The proportion of elephant calves in a herd is less than 22%, the other members being 20% males and 58% cows (based on 1977 count of Bandipur). The mothers hold their calves close to themselves in the herd, beyond tiger's predacious courage, and therefore the chances of killing of elephant calves are very limited.

The elephant, once found over an extensive area, is now confined to two major regions, the eastern region where there are 8000 elephants even today, and the southern part of the Western Ghats (in Bandipur Reserve alone there are 1187 elephants plus 500 in the adjoining sanctuary of Madhumalai, and in Kerala, the State (known as the State of the elephant), the number is still more. Some isolated groups are in the Simlipal Hills of Orissa and in the foothills of the Himalayas from Dehra Dun to Dudwa. In the Corbett Reserve there is a herd of 115, and in Dudwa there are 25 elephants. There is another herd of 35 elephants in Palamau. It is a recent (Sunder 1900) escape from some domestic stock. This has now turned wild. The discontinuity of distribution of the elephant is primarily because its corridors of migration have been blocked by human encroachment.

The rhinoceros does not live in herds. Mother and calf are solitary. There are about 800 rhinos in Kaziranga and another 600 in the other areas, including Nepal and Bhutan. There is a record of 11 calves being killed by tigers in 1968 in the Kaziranga National Park. Predation on rhinos is highly localised.

Co-predators :

The leopard (*Panthera pardus*), the second large predator, is found throughout India including the temperate region of the Himalayas and the scrub lands of Rajasthan. But it is

absent in the Sunderbans where tiger achieves high population concentration. The leopard dislikes marsh and this explains its absence in the delta. There are no countrywide figures of the population of leopards. The estimates of their populations from some of the Reserves are available which indicate their habitat preferences. The dry deciduous forests—(Ranthambhor, 9.0/100 sq. km.) appear to be the ideal habitat for the leopard. It co-exists with the high population of tigers. The Corbett Reserve supports a population of 6.7 and Palamau 6.5 animals per 100 sq. kms.

Wild dogs (*Cuon alpinus*) too have a wide distribution in India except the Sunderbans, the arid regions of Rajasthan and Terai of Uttar Pradesh and the tall savannah of the Assam valley. They are fewer in the Himalayan foothills (yet to be confirmed) but their numbers swell to be conspicuous in the Eastern and Western Ghats and also in the Central highlands in peninsular India. According to Khajuria (1976, personal communication) the wild dog is the principal predator. I agree with him since in predation, consumption and control over prey animal populations, the wild dog is far more efficient and effective than the tiger. There are 80 wild dogs in Palamau, 121 in Kanha, 149 in Bandipur and 200 in Mudumalai (the sanctuary adjoins the Bandipur Reserve). Though they have not been counted, wild dogs are conspicuous in Simlipal and Periyar where I have never missed them.

The jackal (*Canis aureus*) has a wide distribution in the tigerland and has yet not attracted attention of the conservationists. In places like Ranthambhor its population during 1977 was 813. It plays a significant role in the ecology of the Reserve. Their predation is sometimes higher than that of the tiger. Still there is no interaction between the two species.

Hyaena (*Hyaena hyaena*) is a partial predator. It is becoming conspicuously rare in all habitat types in India.

Information about distribution and population of the tiger is available from all the habitat types, primarily because its individualistic life-style and highly developed technique of tracking the species in the field and greater emphasis for its preservation. The presence of 14.0 animals per 100 sq. kms. in Corbett Tiger Reserve in the foothills of the Himalayas rate the habitat as the best in the subcontinent, 11.62 and 10.20 tigers per 100 sq. kms. in Kaziranga and Terai of Dudwa respectively, confirm that the second best habitat types for the tiger is the Terai plains of the wet savannah. As the foothills and the Terai plain ecosystems adjoin each other and the animals of these systems shift from one to the other even during the course of season and in many cases even the same day, the ecosystems have been grouped together for assessment. The high population of tigers in this foothill-Terai ecosystem is due to rich prey population, excellent cover and sources of water. The hunting records of Nepal, Cooch-Bihar (West Bengal), Gauripur (Assam) (Shankhala 1978) also lend

cristatus) is of some significance as a prey of the big cats. The largest concentration of the bird is in Sariska and Ranthambhor regions in Rajasthan. With protection it is showing up in all reserves except the Sunderbans which is not the habitat of the bird.

Even camels have not been out of reach of the tiger. I had an occasion to study a tigress feeding on a camel—the event has been photographed for the first time. The way in which this animal of curious anatomy is tackled by tiger is interesting. Instead of working from the haunches, it starts working from upper part of the thorax of the carcass.

The range of distribution of the buffalo (*Babulus bubalis*) was also wide formerly, but now it is confined to the eastern region (in Kaziranga alone the population is 600, and they are more in Manas), a few in Nepal Terai and a small herd in Indravati valley, Bastar. A problem of their crossing with domestic buffaloes in Kaziranga and Manas has recently cropped up. This is resulting in gene-pollution and degeneration of the wild stock.

Among the large prey animals, the elephant (*Elephas maximus*) and the Great Indian one-horned Rhinoceros (*Rhinoceros unicornis*) are the large ones, but are not commonly preyed upon by the tiger. Occasionally, only their calves are killed. The proportion of elephant calves in a herd is less than 22%, the other members being 20% males and 58% cows (based on 1977 count of Bandipur). The mothers hold their calves close to themselves in the herd, beyond tiger's predacious courage, and therefore the chances of killing of elephant calves are very limited.

The elephant, once found over an extensive area, is now confined to two major regions, the eastern region where there are 8000 elephants even today, and the southern part of the Western Ghats (in Bandipur Reserve alone there are 1187 elephants plus 500 in the adjoining sanctuary of Madhumalai, and in Kerala, the State (known as the State of the elephant), the number is still more. Some isolated groups are in the Simlipal Hills of Orissa and in the foothills of the Himalayas from Dehra Dun to Dudwa. In the Corbett Reserve there is a herd of 115, and in Dudwa there are 25 elephants. There is another herd of 35 elephants in Palamau. It is a recent (Sunder 1900) escape from some domestic stock. This has now turned wild. The discontinuity of distribution of the elephant is primarily because its corridors of migration have been blocked by human encroachment.

The rhinoceros does not live in herds. Mother and calf are solitary. There are about 800 rhinos in Kaziranga and another 600 in the other areas, including Nepal and Bhutan. There is a record of 11 calves being killed by tigers in 1968 in the Kaziranga National Park. Predation on rhinos is highly localised.

Co-predators :

The leopard (*Panthera pardus*), the second large predator, is found throughout India including the temperate region of the Himalayas and the scrub lands of Rajasthan. But it is

support to the hypothesis that the ecosystem is the best habitat of the tiger in India.

The dry deciduous forests of Ranthambhor are next in order of merit in tiger density to the famous deltaic swamps of the Gangetic and the Brahmaputra rivers in Bengal. The Sunderbans have 7.7 tigers per 100 sq. kms. They are rated as the second best ecosystem of the tiger in India. Ranthambhor supports 7.33 (as per 1977 count); out of this 3 tigers spilled over to the adjoining forests in 1978, reducing the distribution to 6.3 per 100 sq. kms. This appears to have resulted in sudden thinning of 600 wildboars which strayed in cultivation during crop season. Both the habitats are characterised by extreme conditions and can be classed as critical ecosystems. The former is limiting in water and shelter and the latter in food range, drinking water and inhospitable slushy ground full of spikey pneumatophores.

The Reserve of Kanha, famous for its tiger shows, is the fifth preferred habitat. There are 6.01 tigers per 100 sq. kms. They are said to be (Field Director's personal communication) at their optimum numbers and the new ones would either spill over to the adjoining areas or force the inhabitants to space themselves over a wider range beyond the Park boundaries. The other reserves, e.g., Manas, Palamau, Simlipal, Melaghat and Bandipur, have less than 4 tigers per 100 sq. kms. (3.7, 3.45, 2.32, 3.63, 3.76 respectively). The Kanha and the Palamau Reserves, with their excellent habitat cover, well distributed waterholes, plenty of prey population of the chital and wildboars, and a fairly long history of preservation, do not support population of tigers equivalent to the fragile and critical ecosystems of the Sunderbans and the Ranthambhor Reserves.

The low population of tiger in Sariska is explained by comparatively low standard of its management in the past where grazing and human movement continues. With its coming under the umbrella of the Project Tiger, the habitat conditions would return to its natural level, and thereafter population density of tigers is expected to increase.

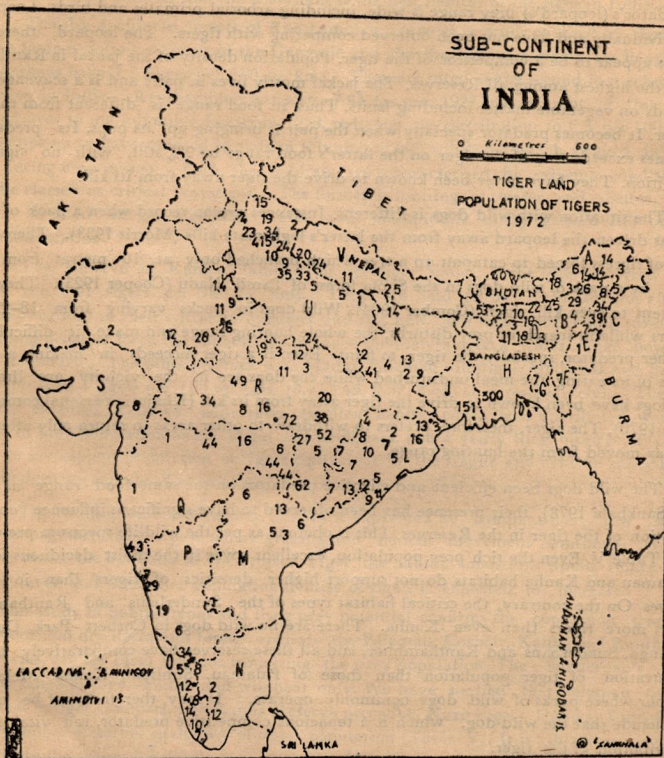
This study of habitat types and their prey potential confirms the conclusion that moist deciduous and dry deciduous forests, specially the Palamau, Corbett, Kanha and Ranthambhor ecosystems, are the ideal ones for sustaining the prey population. The Sunderban's provide narrow range of prey—chital and wildboar only. We have studied that Palamau does not rank first in tiger numbers, nor Kanha Reserve precedes Kaziranga, Dudwa, Sunderbans or Ranthambhor Reserves in density of tiger population (Table V). It is therefore necessary to investigate the reason for tiger's not preferring the otherwise ideal habitat types. One reason can be competition. Let us follow the rule of elimination and discover the factor responsible for low population density in these ecosystems. For the purpose of this study let us examine the leopard, jackal and wild dog—the probable competitors of the tiger. Population densities of the leopard in Ranthambhor ($9.0/100\text{km}^2$) and Corbett ($6.7/100\text{km}^2$) Reserves are higher than in the other ten Reserves. Moreover, the overlap of tiger and leopard is marginal since

the predator's (leopard's) prey range is wide, including arboreal primates and birds. Leopards live individually and have not been observed competing with tigers. The leopard, therefore does not appear to be a competitor of the tiger. Population density of the jackal in Ranthambhor is the highest among all Reserves. The jackal mostly lives in pairs and is a scavenger. It also feeds on vegetable matter including fruits. Thus, its food range is different from that of the tiger. It becomes predator specially when the pair is bringing up its pups. Its predation sometimes exceeds that of the tiger on the latter's food range by 9% still, with no sign of competition. They have never been known to drive the tiger away from its kill.

The situation with wild dogs is different. Instances are on record when a pack of wild dogs has driven the leopard away from the latter's legitimate kills (Morris 1933). There is a record of tigress forced to catapult up a tree which branched only at 10 metres from the ground, by a pack of wild dogs in the Shola forest of Tamil Nadu (Cooper 1923). They are competent to even kill tigers (Comber 1904). Wild dogs in packs varying from 18-22 in numbers while in search of prey disturbs the whole hunting range and make it difficult for any other predator, specially the tiger, to hunt. Even if a tiger succeeds in making a kill, chances of its eating the meal undisturbed while the dogs are in the vicinity are limited. Wild dogs have been known to drive the tiger away from its kill (Khajuria personal communication, 1970). The tiger, therefore, prefers to withdraw to other areas to return only after the pack has moved from the hunting range.

The wild dogs been efficient and effective predators on the same food range as the tiger (Sankhala 1978), their presence has been observed to have significant influence on the population of the tiger in the Reserves. This is obvious as per the wildlife spectrum presented in the Table V. Even the rich prey population, excellent cover in the moist deciduous forests in Palamau and Kanha habitats do not support higher densities of tigers than in other Reserves. On the contrary, the critical habitat types of the, Sunderbans and Ranthambhor support more tigers than even Kanha. There are no wild dogs in Corbett Park, Dudwa, Kaziranga, Sunderbans and Ranthambhor, and all these reserves have comparatively higher concentration of tiger population than those of Palamau, Simlipal, Kanha, Melaghat, Bandipur where packs of wild dogs commonly operate. It may, therefore, not be unsafe to conclude that the wild dog, which is a tenacious competitive predator, is a vital factor in distribution of the tiger.

We have observed that the Indian Tiger is distributed over a wide range of habitats from the foothills of the Himalayas, where it has wide prey range and rich population of chital, sambar, wildboar, hog deer, excellent cover of grasslands and where it drinks clean spring water of the mountains. It exists on muddy delta of the Sunderbans where it survives on chital and wildboar and drinks salt water of the Bay of Bengal. Its high concentration is marked in the wet plains of the Brahmaputra river and the Terai lands of Dudwa



in the north where food range is wide and cover is excellent. Its home is also in the Central highlands of peninsular India and in the evergreen forests of Western Ghats with ideal condition of living. It also lives in open dry deciduous forests of Rajasthan. But the study confirms that the preference of the tiger is for the habitat type which not only supports wide prey range and good prey populations but also which ensures freedom from competitive co-predator, the wild dog. The Corbett Reserve, Kaziranga and Dudwa therefore rank as the best ecosystems for the tiger in India. They are followed by the Sunderbans and Ranthambhor.

References

1. Project Tiger 1972 : Anon.
2. Ghampion and Seth, (1968) : Forest Types of India, Delhi.
3. Comber (1904) : Breeding seasons of big game—J. Bomb. Nat. Hist. Soc., Vol. 16 (1) : 176-79.
4. Cooper, G.E.R., (1923) : Tiger climbing tree—J. Bomb. Nat. Hist. Soc., Vol. 27, pp 276-7.
5. Corbett, J. (1955) : Future of the tiger, May 10, 1955, London Times, London.
6. Gee, E.P. (1965) : Wildlife of India, London.
7. Krishnan, M. (1975) : Wildlife of India 1959-70, Bombay.
8. Morris, R.C. (1933) : Wild dog driving a panther from its 'kill'. J. Bomb. Nat. Hist. Soc., Vol. 36, No. 3, pp 744-745.
9. Prater, H.S. (1971) : The Book of Indian Animals—3rd Edition, B.N.H.S.
10. Sankhala, K. (1970) : The vanishing Indian Tiger : Proc. IUCN 11th Tech. Meeting.
11. Sankhala, K. (1978) : Tiger ! The Story of the Indian Tiger—Collins, London.
12. Sunder, D.H.F. (1900) : Palamau District, 1895-1967.

Acknowledgement

I acknowledge with thanks the valuable help given to me by all the Field Directors of the Project Tiger, specially D.G. Wesley of Bandipur (now Conservator of Forests), J.P. Sinha of Palamau, H.S. Panwar of Kanha, Rajan Mathor, Ranthambhor. Sri Vipin Totuka prepared the map and drawings. Discussion with Bharat Singh, Conservator of Forests were very helpful. The probing questions by my friend G.C. Singhvi, a member of the Indian Police Service helped in shaping the presentation. I am thankful to them.

Kailash Sankhala

A Way to Estimate the Number of Tigers

J.P. SINHA*

The solitary life a tiger leads and the vast area over which it wanders in themselves make the task of estimation of its number difficult and the habitat it generally occupies makes it still more difficult. No method so far employed in this country and elsewhere for the purpose of estimating the number of herbivores and carnivores may be straight followed in the case of tiger. The present practice in India to obtain the pug marks of tiger with "Tiger Tracer" and then to eliminate the similar ones by comparing them appears, in the present time known methodology, the only way to estimate the number of tigers in any specified area. Leyhausen (1976) in his report on tiger reserve mentions this method as the best amongst the available techniques.

The application of this method however, independent of other vital consideration, may yield erroneous result and lead to controversy. In fact doubts have been expressed at various important forums in this regard. After undertaking various tests under conditions capable of influencing the impression of pug marks in the Palamau Tiger Reserve, it has been possible to arrive at fairly accurate estimate of the number of tigers.

The first safeguard is required to be exercised in the identification of sex of tiger by pug mark. The difference in shape of heel pad, toes and their relation to each other of the fore paw of a tiger and its hind paw is so significant that if the impression of only hind paw is taken, it may most probably be classified as female. This confusion most certainly may be avoided if the impression of pug marks are taken only from the place where all the four paws have left their imprint. From such points in the field, the impression of right fore and hind paw should be taken with the help of "Tiger Tracer" to be transferred on a single sheet of tracing paper side by side. This will facilitate the comparison of both the right fore and hind paw, if ever any doubt arises in identification.

Second safeguard that is found necessary is the depth of impression of pug marks. The same tiger/tigress may leave behind significantly differing pug marks in shape, size orientation of toes and their relationship to each other etc. if it passes through different types of soil in different state of moisture content. The error on this account, it has been found, may be eliminated if the depth of the impression of the pug mark is also measured and recorded on the tracing. The depth may be found out by placing a small piece of 15 cm. thread tied to two nails across the heel pad of pug marks (the thread touching the rim of the pug marks) and measuring the depth with a steel tape in the centre of it. It has been found that pug

*Field Director, Palamau Tiger Reserve

marks having depth upto 6 mm. do not differ significantly. The distortions leading to confusion, appear when the impressions are more than 6 mm. deep.

The third safeguard that needs to be exercised is to consider the entire tracks the tiger/tigress, make till they get lost. It has often been experienced that the pug marks of two or even more tiger/tigress, on comparison, appear to be of one individual only. If the details of the movements are considered, it becomes possible to arrive at the correct number. For quite some time, the pug marks of two independent tigers on comparison indicated the presence of one only. But after their tracks were followed and studied with reference to the map of the area, it was found that there are two tigers as in the same night they had moved out from places about 6 km. apart. Subsequent trackings confirmed the presence of two individual tigers. Care has also to be exercised when the movements of tigress with cubs are met with. It has been found in the field that the tigress with cubs does not move with them every time particularly when the cubs are small. In such situation the same tigress may be taken as two if pug marks are obtained once she has moved alone and once with the cubs.

Finally, if there appears any doubt at the time of the comparison, the angle formed at the centre of heel pad with the centers of third and fourth toe may be measured. The centre is obtained by placing the pug marks on graph paper and marking the intersection points of longest and widest section of the heel pad and the toes. In a test carried out with 12 samples of the same tigress drawn by six different persons, the S.E. at 95% confidence level was calculated to be $\pm 0.47^\circ$.

With the care and safe-guards mentioned above, the operation of the estimating the number of tigers in the Palamau Tiger Reserve starts every year generally from the first of December and lasts till February of the next year. This period may be changed if required, in consideration of the field conditions. The idea to carry out estimation in summer months, has not been found suitable in the Palamau Tiger Reserve as not many points are available for getting impressions of pug marks except the water holes. The pug marks at water holes get obliterated and even completely lost by the presence of other herbivorous. Tracking too gets difficult and tiring on account of heat. Between December and February, however, the field conditions are such that the chances of getting pug marks are maximum. To improve the chances of getting good impressions of pug marks, 2 m wide band of fine soil is spread on the unfrequented roads, foot-paths @ three per km. This facilitates tracking immensely.

Once a tracker happens to see any pug mark, he follows it till it gets lost. He also takes the impression of the pug marks of both right fore and hind paw preferably from the imprints of pug marks left on the soil bands. In case, the tiger/tigress happens to go beyond the tracker's jurisdiction, he informs the next man for further tracking. The information is

generally passed through wireless. The tracings with details of track are submitted by the next day to the Beat Office. These are compared daily, separated and kept in a file maintained for each individual tiger/tigress. Simultaneously the track of the tiger/tigress is also shown on map. Track of each individual is shown by different colour. The Beat Officer submits these to the Range Officer who compiles the tracing on the Range level, and finally the number is ascertained at the Directorate level every month for three months. After the number has been ascertained in this way for three months, the average is taken to show the number of tigers in the Palamau Tiger Reserve.

The period for estimating the number of tigers for a week only and that too in summer months is too short as often tiger/tigress get localised at a place particularly when they happen to make a kill when their movements gets restricted. A Tigress may also get localised, if she happens to drop litter round about the counting time. It is also just not physically possible to cover every part of the Reserve with available resources within a short period of a week. In consideration of these limitations, it is advisable to extend the operation for a reasonable period. The prolonged operation also enables us to know the home range of each individual, its overlap with others and subsequent changes in it, if any.

Occurrence of the Nepal Dark Rosefinch, *Carpodacus nipalensis nipalensis* (Hodgson)
at Jogeshwar near Almora (U.P.)

The distribution of Nepal Dark Rosefinch, *Carpodacus nipalensis nipalensis* (Hodgson) as given by Salim Ali and Ripley in the **HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN** Vol. 10 : 168 is "The Himalayas from Western Nepal east through Sikkim, Bhutan and Arunachal Pradesh." During a recent faunistic Survey of the Western Himalayas the senior author collected a specimen of this Rosefinch near famous Jogeshwar temples in Dist. Almora on 26.2.1978. The darker maroon band across the breast and the following body measurements established the identity, beyond doubt.

Wing : 91 mm; Bill : 13 mm; Tarsus : 23 mm; Tail : 60 mm

This record extends the Western range of the species to Jogeshwar (Almora).

Northern Regional Station
Zoological Survey of India,
13, Subhash Road,
Dehra Dun, U.P.

M.L. Narang
B.S. Lamba

A Brief Note on Project Tiger, Bandipur, Karnataka

GENERAL

The forests of Mysore District in Karnataka State have long been famed for their abundant wildlife. They have been used as a veritable hunter's paradise. Shikar for important persons like Viceroys, Maharajas and others were regularly being arranged for Tiger, Gaur and Elephant. The rivers Kabbini and Cauveri are also wellknown for 'mahsheer' fishing and for crocodiles. The Khedda operation organised periodically for capturing elephants at Kakankote on the banks of river Kabbini depended entirely on the high population of elephants in the Begur and Kakankote Forests and their adjoining areas. Some times during the final drive of elephant herds into the enclosure Gaur, Sambar and Tiger have been found.

Expanding population, increasing demand for agricultural land, construction of irrigation projects, excessive grazing by domestic cattle, poaching for flesh, skin and ivory and a general but unfounded feeling that wildlife is safe in the forest led to a gradual steady decrease in their numbers. Wild animals were safe only in the sanctuaries specially constituted for the purpose where they were rigidly protected. Several naturalists and conservationists alarmed at the fast rate at which India's wildlife was disappearing sounded warnings and urged that immediate steps be taken to put an end to the destruction of the habitat and stop the indiscriminate slaughter of innocent animals.

Tiger, one of the most magnificent animals in the cat group, at one time found throughout the Indian continent was found to have been reduced to such low numbers as to be included in the list of endangered species. To save the tiger from total annihilation and to restore its numbers to a viable population a special project—the Project Tiger was launched by the Government of India with the help of International Organisations W.W.F. and I.U.C.N. *Nine areas were selected for the purpose, representing the different types of Tiger and habitat and the Project was launched on 1st April, 1973.

Bandipur Tiger Reserve is one of the areas selected. The area included is 689.52 sq.km spread over six reserved forests contiguous with each other and includes a variety of forests from the dry deciduous to moist deciduous. As the adjoining areas in Tamil Nadu, Kerala and Karnataka are also wildlife sanctuaries there is sufficient room for the wild animals to move about and to expand their territories when populations increase.

CLIMATE:

The Project area gets both monsoons, the south-west from about mid June to September with the heaviest rainfall in July and the north-west in October-November,

The climate is equable with mean temperature of about 24°C. The maximum temperature is around 29.5°C; and the minimum about 18.5°C. Sun is strong in summer and the forests dry and dusty from February to April.

THE FOREST:

The Forest types included vary from the dry deciduous type to the moist deciduous with all the intermediary stages. The main species of trees found are—Teak (*Tectona grandis*), Rosewood (*Dalbergia latifolia*), Mathi (*Terminalia tomentosa*), Dindiga (*Anogeisus latifolia*), Tare (*Terminalia balerica*), Kooli (*Gmelina asiatica*), Honne (*Pterocarpus marsupium*), Jalari (*Shorea talura*), Godda (*Odina woderi*), Hurugalu (*Chloraxylon swietenia*) etc.

Bamboos i.e., *Dendrocalamus strictus* and (*Bamboos arundinacea*) occur. The former in the dry deciduous and deciduous forests and the later in moist deciduous forests and along water courses. At present, the incidence of Bamboo is rather less because of gregarious flowering which occurred about 10 years back. Regeneration is coming up now.

Among the fruit trees found in the forest are *Phyllanthus emblica*, *Terminalia balerica*, *Tamarindus Indica*, etc. These fruits are sought after by animals especially Chital.

The common grasses found are *Cymbopogon flexuosus*, *Cymbopogon citratus*, *imperata arundinacea*, *Andropogon Contortus*, *Themeda cymbra*, *Themeda imberbis* and *Spathobolus Roxburghii*. The grasses reach a height 1½ to 2 metres during the rains. During summer they dry up and become inflammable.

In addition to the above main types of forest there are marshy areas where tree growth is sparse and confined to species like *Randia uliginosa*, *Butea monosperma*, *Carex arborea*, *Zyzyphus xylopyras* etc. These marshy bits are also covered with dense growth of grasses which remain green even during summer. Here and there in low lying areas water collects and is generally available throughout the year. These marshy bits provide welcome shelter, fodder and water to animals during the pinch period.

FAUNA:

The fauna consists of Elephant, Gaur, Sambar, Chital, Wild Boar, Four-Horned Antelope, Barking Deer, Wild Dog, Sloth Bear, Mouse Deer, Hare, Mongoose, Python and a variety of birds. The birds most commonly seen are Peacock, Partridge, Quail, Mynah, Lapwing, Crested Hawk Eagle, Hoopee, Wood Peckers, Vultures, Spot Bill, etc.

The most conspicuous animal of these forests is the elephant. Elephants are found in herds roaming about in different parts of the reserve at different times. They also freely move about in the adjoining areas of Mudumalai, Wynad and Nagarhole. In temperament they are generally well behaved and tolerant. The herds consist mostly of females and

young ones with some sub-adult males. Adult males are sometimes found with the herd, but are generally alone and some distance away from the herd. Elephants can be seen at close quarters especially when they come to the ponds for drinking water and for bath. Watch Towers and Machans have been constructed from where these animals can be seen and photographed. Other animals that can be seen at the water holes are Sambar, Spotted Deer, Wild Boar, Gaur and occasionally Tiger and Panther.

Chital can be seen in large herds around Bandipur, Kekkanahalla, Sulekatte, Mulehole and Kalkere. By far the largest concentration is found near Bandipur. The forest here is of the open park like type with large extents of grass lands. The Chital can be seen freely grazing in these areas. These animals have developed a habit of coming into the campus area during night and have thus become a source of delight and excitement to the tourists.

The Indian Gaur (Bison) were quite common and could be, invariably, seen about 10 years back. A large number of these animals died of rinderpest which broke out during the years 1968-69. Since then there has been slow but perceptible recovery in their population. They can now be seen occasionally in herds of about 10 to 20 animals. They are, however, very shy and rarely come into the open in Bandipur section. In the forests to the west of the Reserve i.e., Begur State Forest and A.M. Gudi State Forest they are met with more often. Composite herds of 60 to 70 animals are seen now and then; but herds of 10 to 15 animals are met with more often.

Sambar are found everywhere throughout the Reserve. They are generally seen in small groups of 3 or 4 animals. The largest single group of these seen at a water hole is 22 animals. They are, generally shy but habitually stop, turn and look back after running a short distance.

Wild Dogs are seen in packs of 10 to 15. Their normal prey is Chital and Sambar. The best time to see them is in the early mornings and evenings when they are most active. They are not easily scared.

Among the other animals the most often seen is the Wild Boar. These are also found in sounders of about 10 to 20 animals.

The Tiger and Panther are met with occasionally. More often we come across their pug marks. A record of tracings of the pug marks has been maintained. Remnants of kills made by tigers and panthers are also seen quite often. Their prey consist of Chital, Sambar, Wild Boar and domestic cattle. A record is kept of the kills reported and observed. At one time it was a regular practice in these areas to sprinkle the carcass of the animal killed with some poison like follidol with the intention of killing the Tiger. This practice is now given up as compensation is being paid for the cattle killed. It appears the Tigers

have also realised the danger of going back for a second feed. In several instances observed by us inspite of the careful precautions taken to avoid disturbance, tigers did not come back for second feed.

Panthers are more often seen than Tigers. They are sometimes found on trees, but more often going about along the road in a leisurely way.

The conspicuous bird seen is the Peacock, especially around Bandipur.

WATER SUPPLY:

The main rivers flowing through the Project area are the rivers Nugu, Moyar and Kabbini. The river Kabbini flows along the westernmost border of the area. The river Nugu flows through the area and is the main source of water for animals in the adjoining forests. There is an ancient Dam constructed across the river Nugu called Sulekatte. It is built up of huge boulders and is even now effective in impounding water. The canals through which water was taken, probably, for cultivation in the distant past have long fallen into disuse and are no longer effective. However, their traces can still be made out. Being in the midst of the forest and covered on either bank with dense growth of Bamboo it has given shelter to crocodiles. Crocodiles have been seen several times and clutches of eggs have also been spotted.

The river Kabbini is much bigger than Nugu. An irrigation dam has been constructed recently across this river. The back waters spread along the border of the tiger reserve. The lake thus created has great potential to be developed as a tourist spot.

The river Moyar flows through a magnificent gorge on the southern borders of the Reserve. The gorge which is 260 m. deep in places with banks steeply vertical or even overhanging with the river below broad and turbulent is an awe inspiring spectacle.

Apart from the above mentioned rivers there are a number of smaller streams which generally dry up during summer. Of these, the most important one is Kekkanahalla flowing along a part of the southern borders of the Reserve. The other important streams are Hebbhalla, Aidasanhattihalla and Chamanhalla. Though these streams have water only seasonally they play an important part in the life of wild animals. Water collects and remains available over the greater part of the year in the depressions and crevices of stony outcrops in the stream bed. Animals come to these spots regularly. Elephants dig up the sand bed for water. A feature of these streams is the abundant growth of mango trees along the banks. The fruit of these trees are very sour and unedible. The fruit production is profuse and the kernels of the ripe fruits are eaten by the Malabar squirrel and Porcupine. The pulp of the unripe fruit is also eaten to a limited extent by Malabar Squirrel.

The water resources of Bandipur Tiger Reserve have been augmented to a considerable extent by construction of small tanks and water holes since a very long time. In Bandipur itself there are a number of tanks like Bandipurkere, Tavarekatte, Kolakamallikatte, Nanjanapurkatte, Kethallikere, Karigowdanakatte Atnikatte; Arlikatte, Huvinakatte, etc. Since the inauguration of Project Tiger the following tanks and Pick ups have been constructed to make water available throughout the Tiger Reserve.

Kadagadamaradakere, Neralethalkolachi, Mattimaradakolachi, Doddamuthigekere, Alangikatte, Cheluvvarayanakatte, Chowdallikatte, Waranchi Pick up and Puradakolly Pick up, etc.

With the construction of few more pick ups and tanks during 1976-77 and 1977-78 there will be sufficient water available throughout the year and throughout the Reserve assuming that the rainfall will be normal.

COMMUNICATION:

Bandipur is easily reached being 80 kms. from Mysore City along the State Highway from Mysore to Ootacamund. There are buses plying regularly along this road and Taxis can be hired at Mysore or Ootacamund. The nearest Airport is Bangalore 138, kms. from Mysore.

Within the Reserve, except in the Tourism zone, the roads are few and poorly maintained. The road connecting Bandipur with Chamanhalla, Kalkere, Begur, Chikbargi, Moleyur, Banurgadde, Gundre have since been repaired and are now jeepable. In addition, roads leading to the important forest Blocks which are faunistically rich like Ulsoorgadde, Puradakolli, Alangikatte, Sulekatte, etc. have been constructed. These roads serve a most useful purpose in enabling the quick transport of men and materials to detect and prevent forest fires and poaching. The total length of old roads repaired and maintained is 143.30 kms. In addition 75 kms. of new roads have been formed.

The Bandipur Tourism Zone is the area best served by roads. Visitors are taken along these roads in the mornings and afternoons in Vans. The roads are so laid as to cover almost all the reaches of the zone and most of the tanks and pools. No night drive is permitted. Bandipur after sunset belongs entirely to its wildlife.

(To be continued)

D.G. Wesley
Field Director
Bandipur Forest Reserve



Uttar Pradesh's
Twin Attractions

FOR LOVERS OF WILDLIFE
CORBETT NATIONAL PARK
DUDWA NATIONAL PARK

Corbett National Park is famous all over the world for its scenic grandure and its wildlife—elephant, tiger, deer (several species) and a host of other mammals, birds and reptiles—the Ghariyal and snubnosed crocodiles and the mighty “Mahasheer” fish.

DUDWA Sanctuary now National Park famous for its only surviving herd of 2000 Swamp deer, Tiger, Spotted deer, Sambhar, Hog deer, Barking deer, Sloth bear, Wild boar, Marsh crocodile and hundreds of colourful birds. It is a paradise for bird watchers. *Conducted tours arranged.*

All Amenities provided.

Write to :—

CONSERVATOR OF FORESTS

Wildlife Preservation Organisation

17, Rana Pratap Marg,

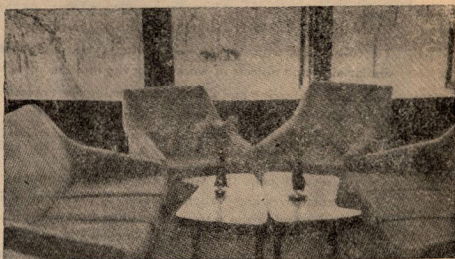
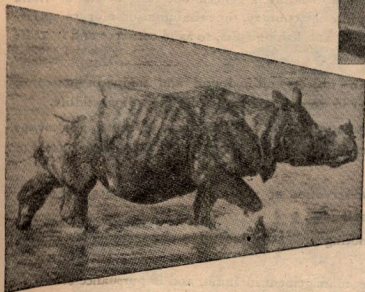
LUCKNOW

Tel : Wildlife :: Phone : 26140



Have a drawing-room view of wild animals

VISIT



**JALDAPARA
WILD LIFE
Sanctuary**

- *Home of One-horned rhinoceros.
- *Gaur, elephants, tigers.
- *Varieties of deer and other animals.
- *Furnished Tourist Lodges with full catering arrangement.
- *Approachable by Road, Train and Air.
- *Jeep available.

Please contact :—

**DIVISIONAL FOREST OFFICER
COOCH BEHAR
(Phone C.B. 247)
WEST BENGAL**

OR

**FOREST UTILISATION OFFICER
8, Lyons Range, CALCUTTA
(Phone 22-2774)
WEST BENGAL**

The Wildlife Preservation Society of India

1. The aims and objects of the Society are :—

- (a) To promote interest in and impart knowledge regarding the preservation and conservation of all forms of wildlife, particularly among the youth of the country
- (b) To co-operate with the Govts. of India and States and with other Societies and Institutions having similar aims and objects in working for the interests of wildlife
- (c) To assist in enforcing and actively supporting the Forest Acts, Wild Birds and Animals Protection Acts and Rules etc. of States and the Indian Arms Act and Rules in so far as they pertain to wildlife and to bring to the notice of the authorities any infringement of the same and to assist in the detection and prosecution of offenders in respect of such laws
- (d) To advise and help the Govt. and wildlife administrators in the formation, maintenance and protection of Sanctuaries and National Parks, the preservation of wildlife in general and rare species of India in particular and in the introduction of exotic species into the country, the rehabilitation of rare species etc. and in the revision on rational lines of the shooting and fishing rules, so as to conserve and increase wildlife stocks.
- (e) To raise funds for the carrying out of the above aims and objects and to found and maintain museums, reading rooms and libraries of natural history in order to disseminate knowledge regarding wildlife.
- (f) To promote sportsmanship in shikar and to recognise well regulated shooting and fishing, as a means of preserving wildlife and fish so that through wise use the surplus may provide a recreational asset to the nation.
- (g) To carry out publicity and propaganda for the preservation of wildlife in India by means of monographs, journals, films, film strips and other feasible methods.
- (h) To assist members of the Society in obtaining shooting and fishing facilities and facilities for viewing and photographing wildlife in India
- (i) To conduct research into the problem of Wildlife management in India, and in pursuance of this, to initiate, encourage and, where possible assist in projects for the study of threatened species and related subjects and to provide reference and research facilities for such work
- (j) To carry on such other activities which will serve the above subjects

What membership of Wildlife Preservation Society of India will entitle you to ?

1. You will become an active member of the growing group of Wildlife enthusiasts, who enjoy working for and spreading the knowledge of how to conserve India's heritage of Wildlife for posterity.
2. You will be entitled to the full use of the library of the Wildlife Preservation Society and of its reading room.
3. You will receive a membership certificate.
4. You will receive personal Identification and Membership card.
5. You will be entitled to buy all publications of the Society at a concessional rate
6. You will be entitled to buy at concessional rates the Society's Tie, and the Balance of Nature Game (specially published in colour for its educative and recreational value).
7. You will be supplied "Cheetal", journal of the Society free.

For membership particulars write to Honorary Secretary, Wildlife Preservation Society of India, 7 Astley Hall, Dehra Dun.



Two Tigers sleeping in Sal Forests Kanha



Sambhar herd in Ranthambore.

(See Article on Page 35)

Patron in Chief:—The President of India.

Honorary Patron:—Shri H.M. Patel, Home Minister (India) and Chairman Indian Board for Wildlife.

President:— Col. Pratap Singh Malvendra
of Nabha

Executive Vice-President:—Shri T.S. Negi.
I.P. (Retd.)

Hony. Secretary:—Dr. R.N. Misra

Treasurer:—Dr. S. K. Sangal.

Hony. Asstt. Secretary:—Shri N.K. Gaur.

Delhi Branch

President:—Shri Pratap Keshari
Deo of Kalahandi, M.P.
4 South Avenue, New Delhi.

Exe. Vice President:—Col. Sher Jung,
A-2/4 Model Town, Delhi

Hony. Secretary:—Commander K.N. Bahl
G-28, Nizamuddin West, New Delhi.

Assam Branch (Shillong)

Hony. Secretary:—Mr. M.A. Islam, I.F.S.
Chief Conservator of Forests, Assam
(Gauhati)

Bihar Branch (Monghyr)

President:—Kumar Surindra Singh
Tal Kothi, Gidhaur

Editorial Board

1. Dr. R.N. Misra. 2. Dr. S.K. Sangal. 3. Shri N.K. Jain.

Buy from the Hony. Secretary, Wildlife Preservation Society of India 7, Astley Hall, Dehra Dun.

	Price
(1) Society's Tie (with Cheetal head in gold on green silk)	... 20.00 each
(2) Balance of Nature Game (Postage extra)	... 9.00 "
(3) 'National Parks' by K.S. Sankhala, I.F.S. (Published by W.L.P.S.I.) (Post free)	... 10.00 "
(4) Singh Parivar in Hindi by M.D. Chaturvedi	... 3.00 "
(5) Panther on the Prowl by M.D. Chaturvedi	... 3.25 "
(6) CHEETAL—I.U.C.N. Special Souvenir Issue, 1969	... 9.00 "
(7) " " " " " 1972	... 7.00 "
(8) Back Numbers of Cheetal	... 7.00 "

Edited by Dr. R.N. Misra, Dr. S.K. Sangal and Published by Dr. R.N. Misra, Hony. Secretary for the Wildlife Preservation Society of India (Phone: 5392, Gram: Cheetal), 7, Astley Hall, Dehra Dun and

Printed by T.C. Sharma at Dun Printing House, Rajpur Road, Dehra Dun.